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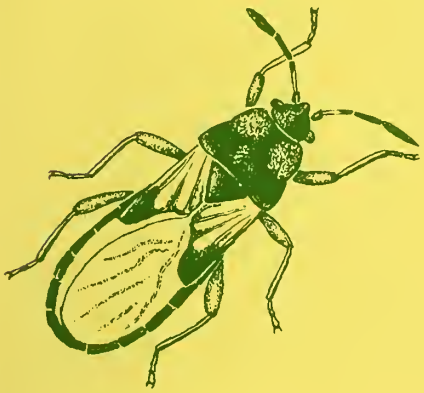
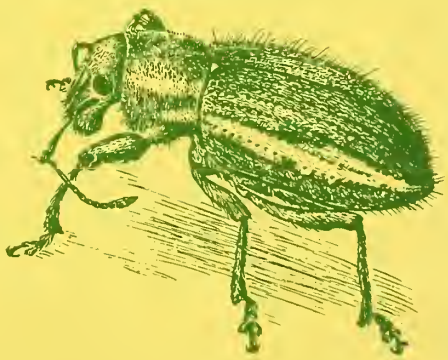
Proceedings PLANT PEST CONTROL MEETINGS





AGRICULTURAL RESEARCH SERVICE
U.S.DEPARTMENT OF AGRICULTURE

A R S-81-4
JUNE 1957

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P R O C E E D I N G S

PLANT PEST CONTROL MEETINGS

New Brunswick, New Jersey - February 6-8

Berkeley, California - February 13-15

St. Paul, Minnesota - February 18-20

State College, Mississippi - February 25-27

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FOREWORD

I should like to say a word about our purpose in holding these meetings. Crop protection has become a broad and complex field. As we strive for greater economy and efficiency in the production and handling of our agricultural commodities, the early detection and control of incipient infestations of insects and diseases, weeds, and parasites of all kinds, becomes increasingly important. Security against either the accidental or intentional introduction of crop destroyers warrants our careful attention.

It doesn't take much imagination in this day of overnight transportation from many parts of the world -- high taxes, high labor costs -- increasing competition for world markets -- and pesticide residue worries, to conclude that whenever possible -- even at considerable cost -- it is much better to live without than to try to live with such pests as the corn borer -- the pink bollworm -- Japanese beetle, Medfly or the fire ant. We want to keep out of the country major crop pests that we don't now have -- eradicate some we do have -- and to come to a little better terms with those that we can't handle in any other way.

The idea of holding some regional meetings of this kind began to take shape when Dr. Frank Todd, who represents the Administrator of the Agricultural Research Service in matters relating to Civil Defense, began a study to determine just how well prepared we are to meet our responsibilities in case of a national emergency. Quite naturally this led to some speculation as to just how well prepared we are to meet emergencies at any time. After all - in our kind of work we are constantly confronted with the unexpected. If we are prepared to do a good job in peacetime, only minor adjustments in organization and procedure should be necessary in time of a major crisis.

Out of this meeting we hope will come some further degree of orientation for people in our own organization, many of whom have assumed added responsibilities in recent months -- a better understanding of Federal-State relations in dealing with regulatory and control problems -- a fuller knowledge of facilities available to us for meeting our objectives in an intelligent manner -- and with due regard for economy and efficiency.

Those of us who spend much of our time pushing papers will be better prepared to do our job if we know what you are thinking about -- the "soft spots" in our operation -- and the type of obstacles you encounter from day to day. We want you to look upon this meeting as a conference in the true sense of the word -- one in which we all participate.

W. L. Popham

LET'S HEAR ABOUT IT

Philip Alampi, Secretary
New Jersey Department of Agriculture

You will recognize, I am sure, that the subject I have been asked to discuss seems to be outside of most of the technical categories listed in your program.

Obviously, there is little that I can contribute in the technical aspects of your field. There are others in the several branches of the sciences which you represent who are much better qualified. However, I am interested in your proceedings and especially in those phases of regulatory programs concerned with plant pest control measures conducted jointly by Federal and State agencies.

It is my understanding that, in general, such cooperation has been effective. An effort has been made to provide for utilizing as efficiently as possible the facilities, the funds, the personnel, and the authority of the Federal and State agencies involved.

Naturally, such working agreements call for compromises and adjustments to meet prevailing situations, or legislative provisions, or current emergencies. There may be involved different viewpoints. There may be prescribed procedures or commitments from which either agency is reluctant to depart. There may be different legal interpretations, and you know how difficult it is sometimes to get our attorneys to yield a point or to compromise on terminology. There are other questions and matters involved.

My topic concerns the field of communications; that vast field in which we all play a part, one way or another. Some of us are concerned with communications as we seek to get attention and to circulate information. Others are engaged in the actual distribution and circulation of such information through the various available media. And third, all of us are on the receiving end as we hear about, or see, or receive information about what is going on around us.

I think we understand, in general, the background of our joint regulatory and pest control programs. You have demonstrated that you are ready to go to work and are competent as specialists or technologists. However, there is another group, an important group, which I fear is often overlooked. I refer to the public, both the general public and especially that portion of the public located in the area of your operations and also that portion of the public directly concerned with the control measures involved. For instance, they might be nurserymen, lumbermen, dairymen, fruit growers, potato growers, or some similar group.

Our relations and responsibilities to the general public and to these special groups are important to us all as public officials. And on that

score, I would like to submit a few observations. You know I speak as one who only recently has assumed responsibility for such activities in New Jersey. Consequently, my viewpoint may be somewhat different from that held by some of you. I readily acknowledge your years of experience as technicians. But likewise, I might claim some years of experience spent on the sidelines observing some of your operations, and in more recent years I have been on the receiving end, one to whom your announcements have been directed for transmission to the public.

So much for this background. There are several general impressions I have gained.

First - you do a pretty good job as technologists in carrying out your duties. In other words, you seem to be well qualified and competent. Generally, you are effective in whatever you set out to do.

Second - somehow, I am led to believe that some of you like to carry out a project in a rather perfunctory manner, following the prescribed rules, enforcing the regulations, exercising police authority.

Third - as technologists there may be a tendency at times to feel that you know best what needs to be done and how it should be done, with procedure based almost exclusively on your own concept of your task tending to subordinate the interests of the public or the industry concerned to your concept of the job at hand.

Fourth - a tendency to avoid taking the public into your confidence, a tendency to feel that the public perhaps is not capable of understanding what you are doing.

Fifth - a preference to discuss your work in technical terms or in the jargon of bureaucrats, whenever announcements are prepared or regulations are issued, using involved terminology developed primarily to meet legal requirements.

Sixth - neglect to consider the importance of proper timing or allowing for sufficient notice to all concerned.

Seventh - neglect to recognize the opportunity which every project or job offers to you to win public good will and recognition for your profession and for the agency you represent.

Now, this may sound like a rather serious indictment but I want to assure you that these observations are offered in a friendly and constructive effort to further these programs. I repeat that I admire your ability to cope with some very difficult insect and disease problems. For that reason, I deplore your neglect of the excellent opportunities that exist to further your own interests by building good will.

In our own department here in New Jersey I must confess that there appear to have been occasions when plant and animal disease and insect problems have occurred, extensive conferences held, regulations considered and eventually developed, regulations distributed, quarantines established

and enforced, and yet never a word has been brought to the attention of the public.

I hope that this will never occur again but I mention it to point out that we, too, are not blameless. Those responsible evidently felt that there was no obligation to report back to the public except when the job was finished.

In our State Department of Agriculture in the regulatory field, we have been making some studies in an effort to appraise our operations. We have been breaking down our Department dollar to see how much we are spending relatively in each branch of our work. It is quite revealing.

I won't burden you with the details, other than those in our regulatory work. For instance, we are spending in the Division of Animal Industry 44 cents out of each of our dollars and we are spending in the Division of Plant Industry 19 cents out of each of our dollars. Combined, that means 63 cents - quite a large slice out of each of our dollars - are going into what is largely regulatory work.

Now, our subject is publicity and public relations. So let's see how much publicity we here in our Department are devoting to those 63-cent projects. Last year our records show that only 15 percent of our releases or news stories were devoted to those 63-cent projects. Of course, the number of releases is not necessarily the yardstick to use. Yet you might consider that yardstick to be one index to use in appraising our work. To me, this means that we are devoting less than one-sixth of our releases to projects in which we are spending nearly two-thirds of our funds. You will agree, I believe, that we have something there to think about. Somehow, I feel that such a disparity should not exist, although again I say that there may be some reason for this unusual ratio. Offhand, it looks as though we should be doing a better job of publicity in those two fields.

Now let's explore a few possibilities in this field. We might spend the afternoon discussing this subject. First, I think you will agree that there is a basic philosophy involved, something basic to the democratic form of government which we cherish. I refer to the principle that our government is responsible to the people. You and I as public servants should never forget that under our American system, our authority stems from the people and we have an obligation to keep the people informed.

You know this is town meeting time up in New England. There the citizen and the office holder meet face to face at the annual town meeting. The citizens get a direct person-to-person report from those who hold office. Unfortunately, that ideal situation cannot be maintained nation-wide but there remains the obligation to keep the public fully and promptly informed.

Here in New Jersey, Governor Meyner has established such a policy. He believes the public will respond to such recognition and will act

intelligently on public questions and appropriations if kept informed. He insists that every agency in our State government should take the public into its confidence. So let's look at your work in terms of those instructions. Doesn't President Eisenhower set an example for us at his press conferences? There, even he takes time out from his busy schedule to report to the people.

Now, regarding my reference to perfunctory enforcement. Unfortunately, some may find themselves devoting most of their time to routine enforcement of certain laws or regulations. Of course, they should not be criticized for doing a good job in the enforcement field, that is their duty, but such routine enforcement with no personal interest in the industry, the products or the people with whom they are concerned would not necessarily be considered a job well done.

Such an attitude is readily recognized by those who are being regulated. Such an attitude tends to stunt or restrict the viewpoint of the agent or inspector himself. So I would urge that he as well as his superiors project their thinking beyond the actual enforcement or policing activities and cultivate a knowledge and interest in the industry or people who are being subjected to supervision or regulation.

Now about my mention of "you knowing best". No one would question your competency on that score, but arbitrary dictation usually arouses distrust and does nothing to promote cooperation. Probably as much or even more might be accomplished by education and information so that there is inspired a feeling of common interest and joint participation. A little of your superior knowledge shared with those whom you are regulating will contribute much toward better enforcement and build good will for you and the agencies you represent.

By all means avoid the tendency toward using technical language and involved statements loaded with the official jargon that creeps into so much that we write and talk about. While it is true that regulations must include all legal requirements, they should be interpreted in lay terms for the public. You cannot expect any editor or radio announcer to use them as they are usually issued, neither will they take time to translate or interpret them. Don't be afraid to issue a simple statement even though most of the qualifying clauses are omitted. The average editor will never publish them all and the average reader is not interested in them.

About timing. One of the worst offenses of officialdom, in my estimation, is the tendency to think only of their own convenience and to overlook the convenience of those whose cooperation they are seeking. Why wait until the last minute to release a notice of a routine regulation or an annual quarantine? Make up your minds as to the details and get it into the hands of all concerned a week or two before it becomes effective. If two agencies, Federal and State, are involved, then it is doubly necessary to avoid last minute decisions.

Now about my reference to neglecting the many opportunities you have to gain recognition for your profession, to win recognition for your programs, to building good will for the agencies you represent. Again I repeat that a job well done is no longer the basis on which performance is judged today. You all know of examples of individuals who through planned publicity may win favorable recognition despite mediocre performance. Let's acknowledge that can happen and remember that is the competition you may face when you are seeking funds for your work.

Besides the fact that you owe the public full information on your work, do not overlook the competition you face for a share of the interest of the average citizen or for a share of his tax dollar. Today every industry and profession recognizes the need for interpreting its work to the public. You cannot afford to neglect your own professional group. You have a good story to tell about your work and about yourselves and the field of science you represent.

Then too, don't forget that you also have an obligation to the agency you represent. If your program is not thoroughly publicized and exploited in every possible channel, how can you expect the public or those in authority to maintain an active interest in your work? How can you expect that funds will be made available unless you have cultivated a favorable public attitude that will win support for adequate funds?

There is another angle to this subject that I believe is pertinent. There is a serious shortage of trained personnel in many fields. Yours is no exception. Efforts are being made to recruit prospective students in sciences related to agriculture. I think you would agree that favorable and consistent publicity on work such as yours might help in recruiting promising boys and girls for high school and college training. That would be a worthwhile contribution.

Further in regard to publicity. Has it ever occurred to you that in a number of respects your job and your activities may appear to be somewhat unusual, perhaps a little mysterious to the average layman? If he lives in a rural area where a survey or a quarantine is being enforced, he soon senses that there are strangers in the community. If he or his neighbors have not been informed, he may become suspicious, he may see no reason for such activities and may become hostile or critical. If informed in advance he is more likely to be friendly and cooperative. That means good will for you and your work.

In closing, let me urge you to include provisions for publicity and information in all of your plans. Make sure that Let's Hear About It is stressed right from the start. Do not forget that there are news possibilities in every phase of any project as it develops. Don't wait until it is all set up and plans are completed. Start when you are first thinking about it and publicize step after step as your plans take shape. Publicize step after step as you carry it out. Continue with publicity on the results, the benefits, the importance. Do not neglect the side-lines, the incidents that occur, the human interest angles.

Each can serve to help to carry your message, each can help to inform the public.

And another suggestion. Has it ever occurred to you that you may not be the person best qualified to determine whether your own project has news value or how and when it should be publicized? Perhaps you are too busy with technical matters to look at your own project objectively. So I would urge you to keep in touch with your publicity or information office and leave to them the responsibility for getting out announcements that will publicize your work. But they are helpless unless they know what you are thinking about, what you are planning. Keep them posted well in advance.

So let's hear about it. Let's make that a part of every project you undertake. Let's hear about it.

ARE WE READY?

Byron G. Allen, Commissioner
of Agriculture, Dairy and Food
St. Paul, Minnesota

In his circular letter of January 15 in which he announced USDA sponsorship of regional plant meetings, Dr. B. T. Shaw, Administrator of the Agricultural Research Service, lists a half dozen items for discussion. Even a cursory look at the prepared program satisfied me that the subject matter has been entrusted to the capable hands of specialists, which is as it should be. I would not attempt to make authoritative comment on each facet of this over-all problem as it is exemplified in the topics assigned to the various participants. I do not hesitate, however, to express myself as an administrator, who recognizes the importance of our own Division of Plant Industry to Minnesota agriculture.

I welcome these discussions because they can help our entomologists, plant pathologists, agronomists, weed and seed specialists, and other Plant Industry personnel assess their assigned duties in the light of possible emergency demands upon their specialized skills. I know from continuous association with these people that they are aware of the important regulatory function they perform routinely in our state, and that they fully appreciate the implications of their role in civil defense. We have talked about this many times. Also, we have had participation by all Divisions of our department in civil defense exercises carried out under the able direction of Colonel Schon.

The action that we can take to meet any threat to our well-being is inevitably limited by the material resources made available to us. Nationally, we observe a continuing debate on the adequacy of our military defenses, whose critics have traditionally sought assurances that we are equipped to meet any possible contingency. To a large extent, regulatory people face the same problems. We can properly evaluate the threat of known menaces on the basis of specific research and past observations, or by realistically analyzing probabilities. If we have not made efforts to meet foreseeable problems in this way, we can properly be accused of dereliction. If, on the other hand, we take steps to adapt our existing facilities, strengthening them wherever practicable, we need not fear that we are neglecting our responsibilities in this area.

In this little talk I want to briefly analyze the civil defense problem in particular, as it relates to our Department of Agriculture's Plant Industry function.

We know that insects and plant diseases may be held to a non-economic level in their native countries by existing parasites and predators.

When accidentally introduced into a new land the absence of such checks may permit fantastic reproduction and damage. Examples of such transfers and their consequences are as well known to our potential enemies as they are to us. They are certainly common knowledge to this audience. In seeking to measure the extent of our preparedness in Minnesota we might dwell a bit upon our analysis of this problem and the steps we have taken within the limits of our resources to adapt to the situation as we see it.

We might safely assume that existing quarantines and inspection facilities would be continued and intensified during periods of national emergency. We wholeheartedly support maintenance of a strong quarantine and inspection force in the U. S. Department of Agriculture. We assume that Federal officials are equally impressed with the importance of this work. We take our regulatory duties seriously in Minnesota, because we know that we have a responsibility to provide our growers and shippers with protection from confiscation and economic loss should other states have reason to suspect that contaminated or infested plant materials are originating in our state. While we do not gratuitously assume that these services are perfect, we look upon past performance in inspecting plant and plant products passing through normal trade channels with a good deal of satisfaction. We cannot be so confident about the more sinister technic of clandestine, purposeful introductions that are the legitimate instruments of modern warfare.

It seems to us that an enemy has at his disposal at least three methods of attacking growing crops. First, our fields might be subjected to attacks with toxic chemicals. The difficulties attendant upon transporting sufficient quantities of herbicides long distances tends to limit the usefulness of this technic. In the case of certain high-value crops and under favorable logistical circumstances, even this device should not be ruled out, however. Secondly, we might expect to encounter widespread dissemination of plant pathogens. I am told that exacting growth requirements (especially fortuitous combinations of temperature and humidity) might limit the effectiveness of such inoculum during a single growing season. If conditions were not exactly right, no epidemic would result. This would certainly be the case were the enemy to attempt even large scale introduction of a virulent race of wheat-stem rust inoculum, for example. Optimum conditions for infection might exist at the time of introduction, but secondary spread would require equally exacting and favorable environmental conditions. Nevertheless, it is not inconceivable that relatively small inoculations of laboratory-bred, high virulent strains could be made which might cause damage in subsequent years.

A third possibility, it seems to me, offers the greatest challenge to us. I speak of the introduction, probably by covert means, of exotic insect pests. Although an epidemic might not develop during the year of introduction, damage to crops could be high in subsequent years. This method appears to offer good possibility of success to an aggressor, at relatively low cost. Many destructive insects are known to exist which fit this specification. Here in Minnesota we can better appreciate such a contingency after discovery just this past summer of the spotted alfalfa aphid in our southwestern counties.

The entomologists tell me that it is not impossible to produce laboratory strains of crop insects which would be tolerant or resistant to known insecticides. Losses could be long-term or short-term, in either case disastrous during a time of national emergency. At best, cost of production would increase at a critical time and the burden of manufacturing chemicals for protection would not be a welcome addition to an already over-worked production machine.

Assuming that this sketchy analysis of the danger realistically comprehends the problem in its broad outlines, what is being done to meet such a situation should it arise?

Earlier in my remarks I tried to illustrate that even normal progress in biological warfare research may confront us with problems that we cannot now anticipate, much less solve. This should not cause us to throw up our hands in despair and put our destiny entirely in the hands of a beneficent providence. In Minnesota we can continue to strengthen our detection facilities, so that they are extensive and alert as our budget permits. In concert with the Plant Pest Control Division, and the U. S. Department of Agriculture, we have instituted an insect survey program during the growing season which uses the talents of every employee in our Plant Industry Division to some extent.

We have decentralized our Plant Industry organization so that District Supervisors are stationed in ten different parts of the state, in order that they might work more closely with county officials. In addition, every town board member and every mayor in the state can be enlisted in any emergency. As a matter of fact, they function routinely as legal Plant Industry Inspectors for this Department.

I have mentioned the importance of geographic distribution of staff and maintenance of a strong detection system. If we have the latter, composed of informed, alert, technically trained men, it seems to me that we will have a good chance of being equipped to meet even completely new emergencies as they arise.

Our greatest resource in any such fight is the technical men in our Department. As Commissioner I feel that I can best advance the interests of our people by strengthening this staff through measures that will enable us to meet competitive bids for their services, and also to provide them with opportunities for self-improvement and training.

We cannot be certain that our defenses are impregnable. I invite your consideration of our approach, and I assure you of my continued cooperation in those efforts which we as State, Federal, and industry representatives continue to make in this phase of agriculture and national defense on behalf of all Minnesotans.

PROTECTION OF CALIFORNIA AGRICULTURE

Charles V. Dick
Assistant Director
California Department of Agriculture

Introduction of a new crop pest to an agricultural area usually results in lower yields, poorer quality, increased cost of production, or any combination of these factors. The end result may be loss of income to the producer, economic distress to the area involved, increased cost to the consumer, and a shortage of the commodity that is affected by the pest. Generally a serious pest outbreak in a major producing area results in very complex and far-reaching economic repercussions.

Government has provided three types of service to help prevent such occurrences, namely, research, extension and action programs. Research and extension are very essential parts of the whole program, but generally speaking they do not completely eliminate the impact of a new pest. Even though an effective chemical or cultural control may be developed, there still remains the cost of applying the control. There are exceptions, of course, such as in the case of some biological control projects which have been more or less self-sustaining after the parasites or predators were well established.

This points up the need for action programs, such as quarantine, pest detection and pest eradication -- and that is what I am to talk about. Perhaps it might be well to mention that in California we have, by mutual agreement and general understanding, a well-defined field of responsibility for each of the publicly financed agencies dealing with agriculture. The State Department of Agriculture at the State level, and the County Agricultural Commissioners, County Sealers of Weights and Measures, and County Livestock Inspectors at the County Level, handle the regulatory, service, and control work. The University of California, through its agricultural experiment stations and agricultural extension service, handles the research, biological control, and extension work.

California agriculture has long been aware of the importance of plant and animal quarantines and pest control. The first California plant quarantine law was enacted in 1881, and provided for the appointment of a Viticultural Health Officer, who was empowered to declare and enforce quarantine regulations subject to the approval of the Board of State Viticultural Commissioners. This was more than thirty years prior to the enactment of the Federal Plant Quarantine Act of 1912.

Although the Plant Quarantine Act was not passed until 1912, despite repeated earlier attempts by California Congressmen to obtain this Federal legislation, there was nevertheless a Federal Insect Pest Act as early as 1905, and the U. S. Department of Agriculture had established a Division of Entomology in 1863 during the second year of the existence of the Department itself. Actually, the first Federal entomologist was appointed

in the Division of Agriculture of the Patent Office in 1854 -- eight years before there was a U. S. Department of Agriculture.

Our first California livestock disease regulatory law was adopted in 1899, and provided for the office of State Veterinarian, and empowered that officer to make livestock quarantine regulations. On the other hand, a Federal Bureau of Animal Industry had been established as early as 1884, primarily for the purpose of eradicating pleuropneumonia in cattle.

I give this background information to show that control of crop and livestock pest diseases was recognized long ago as an essential function of the State and Federal governments, and was, in fact, part of the basis for establishment of the U. S. Department of Agriculture and of the agencies which were later consolidated into a California Department of Agriculture.

California has an unusual need for plant quarantine protection and pest control because of the diversity of climate in this State, and the fact that we grow over 200 commercial crops in addition to our livestock and livestock products. Almost any new crop pest that might gain entry is quite likely to find the right host and environmental conditions somewhere in the State. From this standpoint we are quite vulnerable, but on the other hand our geographical location is such as to make practical the application of quarantine laws and regulations. We are bounded on the north and east by mountains, on the south by desert, and on the west by the Pacific Ocean, thus making entry of pests by natural means almost an impossibility. To gain entry, such organisms must be carried by man or animal, both of which means can be controlled to an appreciable degree by quarantine action.

With respect to plant quarantine and pest control, our State law defines pest as "any of the following that is or is liable to be dangerous or detrimental to the agricultural industry of the State: (1) Any infectious, transmissible, or contagious disease of plants, or any disorder of plants which manifests symptoms or behavior which the director, after investigation and hearing, finds and determines to be characteristic of an infectious, transmissible or contagious disease. (2) Any form of animal life. (3) Any form of vegetable life." It may be seen that this definition is broad enough to cover any form of animal or plant life or any virus disease of plants that may be dangerous or detrimental to our agricultural industry.

The State law also says that the Director shall "prevent the introduction and spread of injurious insect or animal pests, plant diseases and noxious weeds." In an effort to accomplish this objective, we have set up a double line of defense. The first line is prevention of the introduction of new pests. We attempt to do this through our quarantine structure. Our second line of defense consists of a continuous program of pest detection to find incipient infestations of new pests so that we may proceed with eradication, if such action appears warranted.

Administration of the program of plant quarantine and pest control in California involves cooperation between the U. S. Department of Agriculture, the California Department of Agriculture, and the County Agricultural Commissioners. The latter are county regulatory officials who operate in certain phases of their work under the supervision and direction of the State Department of Agriculture.

The County Agricultural Commissioner setup is unique in that it occurs only in California. In fact, these men, originally called County Horticultural Commissioners, were in the field several years before there was any such organization at the State level. Back in 1881, when the first California quarantine law was enacted, there was also enacted a law which provided for the appointment of County Boards of Horticultural Commissioners. Under the quarantine law, the State Viticultural Health Officer, subject to the approval of the Board of State Viticultural Commissioners, had the power to make and enforce quarantine regulations. However, the Legislature did not see fit to appropriate funds for enforcement of these regulations. In those days, mining, lumbering, etc., were important industries in the State, and there was some question as to whether agriculture would ever amount to very much. Therefore, the Legislature took the view that, if agriculture wanted quarantine protection in local areas, the funds should be supplied locally. As a result, the County Horticultural Commissioners were appointed State Plant Quarantine Guardians, and did all of the actual enforcement work in those early years. In 1889, an improved State Quarantine Law was passed, and funds were furnished for a State Inspector at the Port of San Francisco. It was not until 1903, when the office of State Commissioner of Horticulture was created, that the State itself really got into the picture of quarantine enforcement. As a result of this beginning, we now have in California an integrated system of state and county cooperation in the enforcement of quarantine and pest control laws.

Plant Quarantine

We have two general types of authority in plant quarantine inspection work. One is the power to make regulations governing movement of host carriers of specific pests, and the other is the power to take action against shipments based on the presence of pests or the likelihood of their being present. Quarantine regulations are placed in effect only after careful study of the need for such action, and after evaluation of the proposed restrictions, using as a yardstick the principles of plant quarantine adopted by the National Plant Board. They are also reviewed periodically to determine whether they may be modified or revoked. As a result, we believe that our regulations are constantly kept on a biologically sound basis.

For many years it has been our policy to allow entry under treatment and certification whenever a satisfactory treatment is known, rather than to prohibit entry. At the present time we have 22 such formal quarantines directed against other states, and 15 directed against portions of our own State. Only 6 of the 22 quarantines have prohibitory features, and all of these with one exception are directed against plant diseases. We

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also enforce nine Federal domestic quarantines which restrict the interstate movement of certain plants and plant products.

All nursery stock and other plant material capable of carrying pests, whether moved by nurseries or private individuals, are required to be held for destination inspection when entering or when moving within the State. Inspection is then made to determine compliance with State or Federal quarantine regulations and to determine freedom from the pest concerned and from other pests not specifically quarantined against. An exception to the requirements of destination inspection is material moving under the so-called "pinto tag" program, by which nurseries meeting certain standards of cleanliness are permitted to ship stock within the State on the basis of certification at origin. This privilege applies only between counties participating in such an agreement, and is subject to certain restrictions as to the type of stock and the areas to which it may be so shipped.

Plant quarantine inspection is carried on in three different general areas of the State -- at the borders, at the maritime ports, and at interior points.

Maritime inspection, which also includes airplane inspection, is handled by State crews headquartered at San Francisco, San Pedro, and San Diego. At the minor ports, where off-shore ships dock only occasionally, the work is done by the local County Agricultural Commissioners. Maritime work includes foreign quarantine enforcement, as well as handling material from Hawaiian and other domestic ports. Enforcement of Federal foreign quarantines is done under Federal supervision with State men acting as collaborators. During 1955, 18,190 shipments arriving by vessel or airplane were rejected because they were infested with pests or did not comply with State or Federal regulations.

Border inspection is handled at 16 permanent and one seasonal station on the main highways leading into the State. All of the stations are manned by State personnel. Plant material carried by motorists and bus passengers is inspected. Truckloads are cleared as to compliance with quarantine regulations, but the actual inspection for pests is usually made at ultimate destination by the local Agricultural Commissioner. In 1955, over four million vehicles, carrying over 11 million passengers, were inspected. Ninety-two thousand six hundred ninety-nine lots of plant material moving in violation of quarantine regulations or infested with pests were intercepted. Most of this number (81,444 lots) were declared by the passengers after they found out what we were looking for, but 11,255 additional lots were found by actual inspection of the vehicles. We recognize that border inspection is inconvenient to the traveler, and is considered by some as an infringement of their constitutional rights. By instituting an on-job training program for our inspectors, we have been able to improve our public relations and reduce the number of complaints.

Rail, express, parcel post, and truck shipments moving interstate or intrastate are inspected at interior points by County Agricultural Commissioners acting under State law. In 1955, 11,949 interstate and 1,084

intrastate shipments were rejected, representing 5.6% and 0.9% respectively of the total number of shipments inspected. The incidence would no doubt be higher if shippers did not know that their material was subject to destination inspection.

People sometimes wonder if we actually prevent any "bugs" from coming in, or whether we are just stopping host material that might act as a carrier. In 1955, pests were found 12,557 times in material coming through our maritime ports, and 33,033 times at our border stations. All of these were not major pests, but our maritime inspectors did intercept 52 lots of fruit flies, 94 lots of citrus canker, 9 lots of golden nematode, and 39 lots of burrowing nematode, while our border inspectors intercepted 328 lots of apple maggot, 377 of cherry fruit fly, 50 of plum curculio, 59 of European corn borer, 25 of citrus white fly, 13 of sweet potato weevil, 15 of cotton boll weevil, and 9 of pink bollworm. Other serious pests were intercepted a lesser number of times.

We might try to evaluate our quarantine program in terms of one of the insects that we do not have. Since California is the only major cotton-producing state in the United States in which the cotton boll weevil does not yet occur, we might use this insect as a basis for evaluating potential loss. Last year California produced 1,400,000 bales of cotton, valued at $245,029,000, and several years ago the value in terms of cash receipts from farm marketings ran to over $300,000,000. Average annual loss due to boll weevil in the southern cotton-producing states is estimated by the U. S. Department of Agriculture as 10.4%. Applying this figure to the amount derived from cotton at current prices, the potential annual loss to California from the introduction and general establishment of the cotton boll weevil would be between 25 and 30 million dollars. This would be the loss to one crop from one pest during one year. We estimate that the total cost of operating all of our border stations since their inception in 1921, including capital outlay for structures, has been about 10 million dollars.

Pest Detection

The State Department of Agriculture maintains four entomologists and three plant pathologists on a continuous fulltime basis on pest detection work. Each is assigned to a district or area of the State to work with the County Agricultural Commissioners in training their personnel, and in developing and coordinating programs on a state-wide basis to detect incipient infestations of new pests. The bulk of the manpower for these programs is furnished by the counties, and is augmented by seasonal personnel employed by the State.

These detection programs are separate and apart from the survey work necessarily associated with eradication projects and the determination of quarantine lines. They are also separate from the routine nursery inspection work carried on by agricultural commissioners under the guidance of state nursery inspectors. At one time during 1956 we had as many as 20,000 fruit fly traps in operation, in addition to the projects that require visual examination of host plants.

As previously stated, the objective is to detect incipient infestations of new pests -- not to take an insect census or determine population densities. The programs are generally directed toward a specific pest, such as pink bollworm, golden nematode, burrowing nematode, Japanese beetle, fruit flies, and the like. When a new pest is found, the same staff is used initially to delimit the infestation until such time as it is determined whether or not eradication should be undertaken.

I think that I should say at this point that the matter of pest detection is increasing in importance as time goes on. The Florida situation is probably the best current example of the importance of having a good detection program. The Mediterranean fruit fly infestation there was brought to official attention in April of last year by a householder who found a wormy grapefruit in his yard. At first it was believed that the infestation was localized in the vicinity of Miami, but by the time the State and Federal people were able to get a trapping program into full swing, they found that they had over 1,500 separate infestations in 27 counties. The reports from Florida as to progress made toward ultimate eradication of the fly are very encouraging, but the project has cost a lot of money. Ten million dollars, half Federal and half State funds, have already been made available for the project. These figures do not, of course, include the losses to industry occasioned by quarantine treatments and necessary readjustment of cultural and marketing practices, nor do they include the losses and inconvenience suffered by the public generally in Florida. I don't think any one can say with certainty how much of this loss could have been averted by a good detection program, but I do believe that it would have been enough to have paid for maintaining such a detection program for many years.

You might wonder why we don't just bolster up our quarantine effort and take care of the problem that way. Well, it appears to me at least, and I think to a great many other people too, that we are approaching the point where we can't continue to rely on quarantine inspection at points of entry to do the whole job for us. We must spread out in two directions if we are to cope with the difficulties presented by the developments taking place in transportation. Air transport is becoming a problem, both from the standpoint of the speed with which pests can be carried from one place to another, and from the standpoint of pressures that are developing to keep us from slowing down that speed by our inspection procedures. The two directions in which we must spread ourselves are (1) to obtain better information as to pest conditions at point of origin, and insofar as practical to make point of origin inspection, and (2) to maintain adequate pest detection programs in the areas of destination.

I might digress here a moment to tell you that this transportation problem is not peculiar to the plant industry people -- the livestock people are faced with it also. It used to be that most of the livestock and poultry imports were by surface craft, and diseased animals would die enroute or at least were very likely to show symptoms of disease on arrival. Now, practically all of the poultry imports and an increasing part of the

livestock imports are by air. The trip by this method is often shorter than the incubation period of the diseases they might carry, so that the problem of inspection at destination has become further complicated by lack of symptoms.

Eradication

Insects, plant disease and weed pests toward which eradication effort is directed may fall into one of several categories. If eradication is purely of local rather than state-wide concern, probably because the pest already exists elsewhere in the State, the problem is handled by the local Agricultural Commissioner, who relies on the State only for technical assistance. If the infestation is rather small and is confined to a nursery or other single piece of property, the Commissioner usually handles the job even though the pest is of state-wide concern. He may attain eradication by the expenditure of county funds, by requesting or requiring the owner to take certain action to abate the pest, or by a combination of both. Many incipient infestations of new pests have been eradicated by the Commissioners in this manner without much having been heard about it.

When the pest under consideration for eradication is of state-wide importance, and the scope of the project is beyond that normally handled by the Commissioner, the State takes on the assignment, usually with the cooperation of the county. The degree of county cooperation varies, depending on the importance of the pest to that particular county. Often new pests of prime importance to a large segment of our agricultural industry are found in areas of the State quite remote from the main areas of production of the particular host crop. Examples are cherry fruit fly in Siskiyou County and western grape leaf skeletonizer in San Diego County. On the other hand, when Mexican bean beetle broke out in the heart of a 36,000-acre bean area in Ventura County, local assistance toward its eradication was immediately forthcoming.

Insect eradication projects currently receiving attention of the Department concern cherry fruit fly in Siskiyou County, Hall scale in Butte and Yolo Counties, khapra beetle on pretty much of a state-wide basis, and Mexican fruit fly along our southern border. In addition, we are engaged in suppression of walnut husk fly in Sonoma and Napa Counties, pending further evaluation as to the feasibility of eradication. All of these are joint State and County projects with the Federal government participating in the case of Hall scale, khapra beetle, and Mexican fruit fly.

The separate eradication programs are as varied as the species with which they are concerned, and are planned with due regard to the specific biological characteristics of the pest. They do, however, have two major factors in common.

Six years has been arbitrarily established as the minimum period of operations. During the first three years, the treatment measures are applied to all hosts within a predetermined radius of a known infestation. The second three years are given over to intensive survey of the treatment area and its extended periphery to assure that there have been neither survival nor escapes. If at any time during this six-year period a live

specimen of the species under eradication is found, in any stage, the entire six-year program is reinitiated. It may be practical to modify this arbitrary period of six years in dealing with certain of the fruit flies that have several generations in a single season. In such cases, we may be able to shorten the period of treatment.

Experience has shown that complete confidence cannot be placed in visual inspection, or even in trapping, in determining all existing infestation. For that reason, the treatment measures are extended to all hosts occurring within twice the radius of the anticipated seasonal spread of the species.

In the field of plant diseases we are currently attempting, with the co-operation of the Agricultural Commissioners concerned, to eradicate a virus disease of peach known as yellow leaf roll, which occurs in four counties in the peach bowl areas of the Sacramento Valley. We hope that this effort will be more successful than the joint Federal-State-county effort to eradicate peach mosaic in Southern California. In this latter case, we were able to reduce the incidence in commercial orchards to less than one-half of one percent, but it is apparent that we cannot completely eliminate the disease with presently known techniques. We are also engaged in stamping out several infestations of burrowing nematode that occur in nurseries.

In addition to our insect and plant disease projects, we are attempting the eradication of several noxious weeds on a state-wide basis. In this work, State, county, and landowner each bear one-third of the cost.

When a pest becomes so widely distributed that we are no longer justified in applying eradication or intensive control measures at State or county expense, it then becomes the grower's responsibility to control it on his own property. As a means of protecting the growers, our laws permit the County Agricultural Commissioners to serve notices and cause the abatement of such pests when they are allowed to build up so as to constitute a nuisance to adjacent properties.

We do, however, spend State funds in the control of certain species of migratory insects, such as grasshoppers and beet leafhopper, even though these pests may be of general distribution in the State. This is a policy that has developed over a period of years as it became obvious there were certain types of situations under which producers of important crops could not effectively protect themselves. Both of these pests build up on range lands or waste lands that are often great distances from the crops ultimately attacked, and the properties on which they build up are owned or controlled by persons having no financial or economic interest in the pest problem that they present.

FEDERAL-STATE RELATIONS IN REGULATORY WORK

W. C. Jacobsen, Director
California State Department of Agriculture

We have been asked to discuss Federal-State relations in regulatory work, and I am happy to say that they are much better, thank you, as of the present time, but it almost took an act of Congress to shake some realism into these relations.

We will refer extensively to problems in insect pest control, but many of the features involved should be construed to include plant disease suppression, and, in some respects, problems involved with animal diseases. Historically, economic entomology is just about a good hundred years of age. Starting in the 1850's, there were quite a few entomologists, mostly students and collectors. There were many observers on maladies of trees and crops. There were many writings. As a matter of fact, the first State entomologist, Mr. Asa Fitch, was appointed in New York in 1853. Then the first Federal entomologist was Townsend Glover, starting in the Bureau of Agriculture of the U. S. Patent Office in 1854. His job was called "Expert for collecting statistics and other information on seeds, fruits and insects in the United States". In 1877, the U. S. Entomological Commission was established by act of Congress.

So, while the foundation for economic entomological viewpoints was established in the 50's, it was built up during the 60's, ideas for developing it were better spread during the 1870's, and economic entomology really began to flourish in the 1880's. In 1887, the Hatch Act, establishing the experiment stations, provided for station entomologists, and, during the period 1887 to 1893, 25 states selected people to serve in this capacity.

It is appropriate to discuss some of these problems here in California, because one of the pioneer organizations in fostering quarantine and insect pest control was the California Fruit Growers Convention, starting in 1879, after numerous local meetings.

Dr. L. O. Howard, one of the world's most famous entomologists, said, in his "History of Applied Entomology" (Page 21), "It must not be forgotten that California was the first state in the Union to pass proper pest laws, and to set up a rigid quarantine, and that all of the early laws passed by the other states were based on those of California. California, in fact, led the Federal Government in this direction by fifteen years."

Actually, in California it took many years to acquire adequate statutory provisions. In the early Fruit Growers Convention Proceedings, we find many and varied discussions on destructive insects, measures to control

them, and intercounty quarantines to prevent their spread. The matter of state coordination came at a later time. Dr. C. L. Marlatt, in 1919, said it was a twenty-year struggle to obtain the authority found in the Federal Plant Quarantine Act of 1912.

Now, on more current developments.

Between 1933 and 1953, there had been what appeared to us to be a dimming consciousness of the value of one of the most important functions for which the U. S. Department of Agriculture was in business. Obviously, I am referring to the business involved in exercising certain protective functions. Just before the turn of the century, and for a number of years following, this important protective work had been fought for rather valiantly. During the recovery periods following the wars, and especially the depression after World War I, in addition to agricultural adjustment, emphasis was given to research and extension, both of which were sorely needed, but certainly not at the expense of other inherently necessary protective services. A proposal to cut the U. S. Department of Agriculture budget became apparent late in 1953, and showed more definitely in the spring of 1954. Two reasons were given for these proposed cuts: (1) The states and local government should pick up a greater share of the responsibility, including the expenditures therefor, and (2) by making savings in the protective area, it would not appear that the expansion of research and extension would be as costly.

Fortunately, for our type of activity, there were a number of very understanding Senators and Representatives, who insisted that restorations be made, and some instruction emanated somewhat after the following fashion - You people in the U. S. Department of Agriculture should get together with the states and confer and see where the areas of responsibility are; bring us back a program of how, where, when, and how much is involved, and what would it cost. This resulted in the development of a document entitled "Federal-State Relations in Pest Prevention and Control Activities", dated October 4, 1955. This document, in its introductory paragraphs, enumerates that it "is a statement of policy jointly developed by the U. S. Department of Agriculture and the appropriate agricultural agencies of the states". Further "because of their divergent nature, many pest problems require Federal-State cooperation". The Federal responsibilities show that these involve (1) preventing the introduction into this country of seriously injurious pests, (2) preventing the interstate spread of seriously injurious pests, (3) developing, correlating, and evaluating pest information from foreign sources, (4) cooperating with foreign countries, particularly neighboring countries, in the control of crop pests to prevent their introduction into the United States.

The states have a responsibility to (1) prevent the spread of seriously injurious pests by the use of quarantines, (2) develop and administer intrastate quarantines, (3) provide independently, or in cooperation with other states, for the control of native or naturalized destructive pests.

Joint responsibilities include: (1) eradicating or controlling an incipient infestation of a pest new to the United States, (2) preventing interstate spread of pests new to or not widely distributed in this country, (3) eradicating or controlling an unforeseen emergency outbreak of a pest for which no control program has been provided, (4) eradicating an emergency outbreak of a pest against which a control program is in progress, but has developed to be of substantial magnitude whereby to threaten significant losses, or will require larger expenditures if action is not taken, (5) providing for pest surveys to determine and record the presence of pests and the extent of spread, with particular attention to new or potentially serious pests.

Then, in connection with the development and administration of joint programs, there appear to be two main categories: (a) where eradication is indicated and (b) where the objective currently must be one of control and prevention of spread.

The procedures recommend joint evaluation of the problems involved, including work schedules, longer range financing and adjustments in procedures, and financial support as may be required by changing circumstances. The principles involved in this program have already been well tried out for a joint program against Gypsy moth in New England, for intensive control plus eradication of this same pest in an incipient outbreak in Michigan. It got a real workout when Mediterranean fruit fly showed up in Florida. We are hopeful that this document will result in (1) keeping the U. S. Department of Agriculture properly in its protective field, (2) helping to satisfy the congressional mandate, and (3) instilling into the states a renewed vigor in detection work, and greater attention to serving their agricultural industries in keeping out and suppressing injurious pests. There is some hope that it might be a means also even to encourage the strengthening of state departments of agriculture, or maybe to aid in the better correlation of regulatory activities into a single agency in the states.

A comparable policy program has been adopted in the animal disease field. Another such policy program is in the mill covering marketing activities, but this one has been slowed down, because of its complexity.

Our remarks will be confined to a few points that we might inquire into in the interest of better Federal-State relations in regulatory work, and suggest an inquiry as to whether we are emphasizing the following adequately:

(1) In the field of plant and animal quarantine inspection, we are dealing with an area of activity upon which we have aimed to keep the spotlight. It is preventive pest control or quarantine, as contrasted to intensive pest control, which may become a necessary and costly problem after a pest becomes established. Anything that is designed to avoid such a continuing program with its heavy costs, obviously, is desirable. In

the U.S.D.A. Yearbooks, we find in 1952 that the annual insect pest losses in the United States total four billions of dollars, and, in the 1953 Yearbook, plant disease losses total three billions of dollars annually, and these certainly would be no less today.

The states in our western region must continue to think in terms of the importance of their agricultural industries. We have some measure of that importance when we total the cash receipts from farm marketings, which reaches 5 and 3/4 billions of dollars for our eleven Western States and Hawaii. An estimate made by the California State Chamber of Commerce shows the impact upon the total economy of our State is approximately four times the farm value of production. This means, then, that the impact from agriculture on the western area's total economy would be between 23 and 24 billions of dollars. For every one of our Western States, we must still look to markets at great distances, and we must produce quality products, with freedom from defects, and must do it as economically as possible.

Our consciousness in this field, among the Western States, led to the formation in 1919 of the Western Plant Quarantine Board. Other regional boards followed. A National Plant Board was created, and this organization was responsibile for the development of the "Principles of Plant Quarantine". Obviously, those states having the most at stake paid the greatest attention to the value of preventing injurious pest introduction. This Western Board was organized at Riverside, California, in May 1919, primarily to gain some uniformity in viewpoint on the objectives and operation of quarantines. In this there was considerable assistance from the Federal Horticultural Board, which had real heavy responsibilities as the national plant quarantine agency at that time.

What were some of the other things they talked about then? (a) The eradication of a relatively new and limited infestation of pink bollworm of cotton, which had recently gained a foothold in Mexico, but only a scant foothold as yet in the State of Texas; (b) a recently found European corn borer infestation was gaining foothold in the neighborhood of Boston, and in a limited area near Albany, New York. There was going to be an attempt to have $500,000 appropriated to try to eradicate this corn borer infestation; (c) the unfortunate introduction of Oriental fruit moth, through a gift of cherry tree nursery stock by the Emperor of Japan to enhance the beauty of the Tidal Basin in Washington, D. C., although by 1919 there was some indication of the pest in Virginia and Maryland; (d) intensification of effort against a recently imported pest, the so-called Japanese beetle, apparently introduced eight years before on iris stock by the Dreer Nurseries in a small area in New Jersey opposite Philadelphia; (e) the enforcement difficulties becoming apparent in the recently adopted Quarantine No. 37; (f) nematodes as a potential pest of significance. For example, Dr. Harold R. Hagan, of Utah, made this statement there: "When nematology has progressed as far as entomology has now, we shall know that many poor yields are due to nematodes which we, at the present time, know nothing about. The widest field in zoology

at the present time is the study of the nematode." There were also discussions on how the bad pest condition of 1908 and 1909 imports of nursery stock from Europe and Japan gave the needed impetus to bring about the enactment of the Plant Quarantine Act of 1912, but the major stress was on the exercise of the Federal function at the maritime ports and international border entry points. This was before the days of international airports.

With the passage of years, we now are able to visualize the results attendant the spread of some of these pests talked about in 1919, but not adequately curbed in the intervening years. This brings even greater significance to the importance of the Federal quarantine inspection function. Some states have cooperated in sharing this problem to a greater extent than others, largely due to the insistence from leaders of their agricultural industry. It was only a few months ago that it looked like this extra important function was going to be down-graded. Not only had a major portion of the plant quarantine function been turned over to the U. S. Customs Service, but the important phase of baggage inspection was threatened with a permanent cut to a ten percent pest inspection check. Fortunately a test analysis was permitted, and the results were astonishing. According to Ed L. Ayers, Commissioner of the Florida State Plant Board, the results of the normal inspection of personal baggage yielded a 400 percent increase in interceptions, as compared to the reduced check inspection. The unfortunate finding of Mediterranean fruit fly in Florida aided to gain the necessary support for adequate Customs inspection. The sum of $850,000 was indicated for an expansion in this field for the current year, and there is some indication that there will be an additional expansion of $700,000, some of which will be utilized to better stabilize the Customs inspection, with an agricultural representative available in most instances to give detailed and technical assistance. The impetus given by the added financing has shown a marked improvement at the maritime and international airports. Our experience with border customs inspection, to aid in stopping Mexican fruit fly from just across the line in Mexico, has not, up to now, been so heartening, but we are truly hopeful for an improvement comparable to that at the ports.

(2) Our next theme is detection and survey. Certainly, recent events have stressed the importance of extending the "pest detection" technique. It must be recognized that this takes considerable manpower and expense. To be kept on a current basis, it appears best to conduct this type of activity on a joint basis, with emphasis on adequate lures and information to guide the most effective seasonal efforts and areas of potential infestation. This subject has been so well covered under an available mimeographed item by Mr. Charles V. Dick, an Assistant Director of the California Department of Agriculture, entitled "Pest Detection Programs", that we will not dwell on it extensively here, but do emphasize its importance, and the significance of differentiating detection programs for ordinary and regular survey activities. If we are to strengthen the base for the idea of eradicating incipient infestations, then detection assumes increasing stature, particularly in the light of greatly increased speeds in the transportation of people and articles.

We have a State Board of Agriculture in our State, which, as long ago as 1947, insisted upon the establishment of special survey devices to work in cooperation with our County Agricultural Commissioners. These are the men who serve in the counties to do agricultural regulatory work, and serve most effectively as quarantine "guardians" and administrators of laws and regulations in the plant industry field. Provision was made for three entomologists and three plant pathologists to do survey work at the State level, and to coordinate the activities of these county men, as well as to serve in an advisory capacity to them.

Greater emphasis in recent years has been placed upon detection rather than upon survey. The advent of the gin trash machines, the seasonal appearances of Mexican fruit fly in the Lower Rio Grande Valley, certainly gave clues to the importance of detection. Oriental fruit fly expanding in Hawaii keyed us up more particularly to the need, and then the finding of Mexican fruit fly in the Tijuana Valley of Mexico clarified our thinking. The appearance of Mediterranean fruit fly in Florida pretty well clinched the necessity for full utilization of every detection device. This field could well engage the Federal Government in foreign areas in cooperation with the ruling governments similar to that effectively being done in cooperation with Mexico.

(3) Planning for Eradication Programs. These we might divide into two categories:

(a) Wherein incipient infestations of seriously injurious pests, whether plant or animal, are apt to show as a result of "Pest Detection" operations. Are we geared to cope with them? Certainly we cannot go wrong if we have planned a framework of how to proceed. When Mr. A. A. Brock was Director of our Department, he requested that an eradication plan be worked out for at least one major potential insect pest and for one major animal disease threat. Such planning for eradication operations was designed to stand us in good stead whether it comes as a result of natural entrance, accidental introduction, or deliberate establishment for biological warfare purposes. Each level of government can work on this effectively. Fortunately for the setup we have in California, with practically every county having an Agricultural Commissioner, we can figure on a planned program even at the county level. Certainly an exchange of ideas in this field intergovernmentally would be most helpful.

(b) In instances where new methods or techniques revitalize the opportunity to eradicate a pest for which earlier pesticides or cures were unavailable, or were not yet developed. We have in mind the potential for pushing Gypsy moth off the Continent in the New England area. States have struggled with this pest individually and collectively, but it is going to require complete intergovernmental cooperation under a firm

plan if it is going to be accomplished. In this instance, a very complete plan has been proposed, and, in the main, has been approved, even to the extent of having obtained congressional recognition. There undoubtedly are some animal diseases that lend themselves to concerted action of this character.

We might look back a few months, and see what our National Association of Commissioners, Secretaries and Directors of Agriculture did with reference to the three preceding areas we have presented. The recognition of these problems is indicative of the trend of the thinking in the several states. We quote herewith three pertinent resolutions:

PEST DETECTION, SURVEY AND ERADICATION

"Whereas, the development of effective lures and trapping devices gives greater assurance to the ability to detect the presence of seriously injurious pests of agriculture; and

"Whereas, early knowledge of the existence of incipient infestations of such pests can be instrumental in saving against extensive expenditures of public funds after infestations become more widespread; and

"Whereas, adequate detection and survey programs are vital to proper safeguarding against pest spread and/or introduction: Now, therefore be it

"Resolved, by the 38th Annual Convention of the National Association of Commissioners, Secretaries and Directors of Agriculture, meeting at San Francisco, September 17-22, 1956, that we urge an appreciable expansion in pest detection programs by the Federal Government, in cooperation with both the several states and with responsible authorities in foreign countries in the interest of making quarantine procedures more effective and permitting early attention to eradication against incipient infestations; and be it

"Resolved, further, That copies hereof be forwarded to the Secretary of Agriculture, to each of the members of the House Appropriations Committee, to the Bureau of the Budget, and to the members of our Association, in order that adequate budgetary provision may be made to expedite an adjunct of most important assistance to pest prevention and eradication."

GYPSY MOTH ERADICATION PROGRAM

"Be it resolved by the 38th Annual Convention of the National Association of Commissioners, Secretaries and Directors of

Agriculture, meeting at San Francisco, September 17-22, 1956, That the Congress of the United States be commended for increasing the financial support to the gypsy moth program of the U. S. Department of Agriculture so that the Department may start on an accelerated program which can result in the complete eradication of that pest; and be it

"Recommended, That the amount provided in the Federal budget for this program be continued, and if necessary be expanded to insure the completion of the gypsy moth eradication program as soon as possible; and be it

"Further recommended, That copies hereof be forwarded to the Secretary of Agriculture for his information and guidance, and to the members of the House and Senate Appropriations Committee for their earnest consideration."

PORT AND BORDER QUARANTINE INSPECTION

"Be it resolved by the 38th Annual Conference of the National Association of Commissioners, Secretaries, and Directors of Agriculture, meeting at San Francisco, California, September 17-22, 1956, that the Congress of the United States be commended for increasing the financial support to make more complete the plant quarantine inspection at international airports, and at maritime ports, and border points of entry, both by the Customs Service and the U. S. Department of Agriculture; and be it

"Recommended, That the amount provided in the Federal budget for these functions be continued, and if necessary be expanded to insure against the introduction of serious and costly pests of agriculture; and be it

"Further recommended, That copies hereof be forwarded to the Secretary of Agriculture for his information and guidance, and to the members of the House Appropriations Committee for their earnest consideration."

(4) More complete and better availability of information would appear to have an important bearing upon the success of our activities. It implies the need for improved communications. There are very few fields in agricultural regulatory work that have such a backlog of valuable information as in the areas we are prospecting here today, and they involve active and living sciences with new developments hourly. The problem is to get the news about them out to the people who need and use them currently and realistically.

We were asked by our County Agricultural Commissioners to contact the University of California to see if an analysis could be made of potential pests which had not yet arrived in the United States, and even of known

pests as to their potential economic importance. The Director of the Experiment Station at the University of California (Dr. Paul Sharp) came up with the idea that a revision of Dr. Dwight Pierce's Catalog of many potential insect undesirables might serve the purpose. It is now revealed, as a result of Dr. Sharp's correspondence, that many sections reporting on the insect groups have already been brought up to date, and a valuable compendium, directed to the objective above stated, could be completed in about two years. We should do everything possible to encourage this.

Then, the reorganization of the insect survey into a setup responsible for the "Cooperative Economic Insect Report" represents a real milestone. It is of inestimable value to everyone engaged in plant quarantine and insect pest control work. There now is a plan to periodically include in this report notes on "Insects Not Known to Occur in the United States". This is a terrifically helpful development, and goes along with the idea of developing improved communications.

Coordination of data on research developments is vital to our programs in the types of regulatory work many of us here are responsible for, but we must rely upon the written word, in the main, to know about it. Reports are coming through much better all of the time, and these can supplant the more costly procedure of sending trained people to make observations on the ground. Fortunate occurrences frequently come as a result of important people, who advise or help on eradication programs, or who are parties to the development of new pest detection and suppression techniques, showing up at our meetings, or contacting our offices. We have had the advantage, just recently, of talking with Dr. Steiner and with Dr. Christiansen, who have been working on the fruit flies in Hawaii and on the eradication program in Florida. Their cooperation, based upon the development of greatly improved know-how, gave results against Mediterranean fruit fly such as were never dreamed of on such short notice. A new trap, new lures, new spray combinations, proposed by these men, coupled with the administrative responsiveness from Assistant Secretary Peterson, Dr. Clarkson, and Lee Popham, showed how quickly and effectively eradication procedures could be undertaken after some planning and good cooperation with state authorities.

Any detection or eradication program must, in addition to its basic plan, be carefully evaluated and re-evaluated. Its success may depend upon how well proper criteria may have been applied in formulating procedures and in avoiding distressing, if not fatal, loopholes. Much good, reliable information is available, but can be rendered valueless due to insufficiency of communications.

(5) Public Relations. How are they today? Well, at least we're gaining ground in our recognition of their vital essentiality, and they become increasingly important if we are going to keep wheels under what is now moving and not let flat spots develop. Mass media is available to serve us if we will but use it -- press, radio, and television.

The agricultural public ordinarily is quickly responsive -- if they know what we do, how we do it, and, most of all, why we do it. And the same goes for the public generally. We have been singularly fortunate in the western area to have had leaders in our agriculture who have had a faculty for understanding needs and a consciousness of the importance of agricultural regulatory work. They have supported necessary legislation and reasonable budget requests. The tools are in our handed to keep them advised. But that is not enough. Our own people -- in our own services and agencies -- must be steeped in the importance of each and everyone responding to good public relations principles. Federal - State and other intergovernmental relations, even though good, can be made better through sound public relations observances.

In concluding, we recognize that some of our observations sound idealistic, some realistic, and some in between. To sum them up: That other guy (George) really is doing a swell job -- it might be good to let him do it, but it could be better if we planned a little and offered a cooperative hand so he wouldn't have to do it all alone. Most of all, let's keep in touch with one another.

FEDERAL - STATE RELATIONSHIPS IN CROPS REGULATORY PROGRAMS

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New Hampshire Department of Agriculture

Crops regulatory programs originate from the need to protect American agriculture, broadly speaking, from excessive losses which would otherwise result from the ravages of destructive plant pests of foreign origin that have become established in limited areas in the United States, and which threaten to spread over much wider areas in this country. Included in the category of plant pests are insects, plant diseases, nematodes, and other organisms that attack plants or plant products.

These regulatory programs operate within the framework of, or in conjunction with, domestic quarantines, Federal or State, which are intended to prevent or restrict spread of an introduced pest until it can be eradicated or brought fully under control.

If an introduced pest should happen to be discovered soon enough after its establishment while the area of infestation or infection was small, occupying for example a single property or a portion of a single county, prompt action on the part of the affected State alone might result in complete eradication of the pest, providing the means to do so were available. During the period of eradicative treatment, prevention of spread to other parts of the State or to other States might be possible through rigidly enforced quarantine action on the part of the infested State.

Unfortunately, past experience has shown that the problem of dealing with introduced pests is by no means as simple as the above hypothetical case might seem to indicate. On the contrary, introduced pests usually create problems that are exceedingly complex, and for which a satisfactory solution may not be found even after years of effort.

Foreign plant pests rarely announce their arrival in this country in conspicuous fashion. Once they have landed and have got the feel of their new environment they tend to move into more and more distant localities, either under their own power, through channels of interstate commerce, or by other means. Increasing in numbers they eventually attract attention in some locality where they are found to be causing unusual damage. By that time, however, they may already have become well entrenched at many widely separate points, and difficult or even impossible to eliminate completely.

In such cases action by an individual State, however vigorous, could hardly be expected to afford adequate protection to the rest of the country. Moreover, action taken individually by all of the infested States, having diverse interests and operating under diverse laws, might still fail to provide the degree of protection considered necessary by the remaining States, as yet uninfested.

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It is obvious, then, that the Federal Department of Agriculture, with its broader authority, should be best fitted to play the leading role in interstate plant quarantine activity and to coordinate eradicative or suppressive efforts involving more than one State.

Under existing State and Federal laws, any pest control or eradication program within a State must be carried on under State authority, hence it is evident that crops regulatory programs, to be effective, require the cooperation of State and Federal agencies.

The term "cooperation" infers a sharing of responsibilities in a joint enterprise, and in the field of plant pest regulatory work there has developed through the years a better understanding of the responsibilities that should be assumed by each of the participating agencies.

Federal - State cooperative regulatory programs today represent a real teamwork approach to the problem of how to deal with plant pests most effectively.

This rather healthy state of affairs has not been arrived at overnight, by any means! The "growing-pains" have been many and frequent, and at times have approached a real crisis.

If one were to look in to the records of the Regional Plant Boards and those of the National Plant Board, covering the past dozen years or so, one would find that the matter of Federal - State relationships in regulatory programs has come up for serious and lengthy discussion time and time again. Federal activites and State activities have been scrutinized and argued about, and it has been evident that there has been at times a considerable amount of misunderstanding and confusion as to just who should be responsible for what -- and who should pay the bill for such programs.

Matters seemed to be coming pretty much to a head by 1951, when a hearing was held at Washington to consider the possibility of lifting the Federal Japanese beetle quarantine. The vigorous reaction by State regulatory officials, industry, and other groups left no doubt as to how the States felt about the proposal, and the Federal quarantine was retained.

At the same time other Federal regulatory programs of vital interest to the States appeared to be in jeopardy, and some State officials felt that the States were being gradually forced to assume responsibilities in plant pest control that were properly a Federal function.

What was needed was a clear-cut statement of policy that would be acceptable to State and Federal agencies concerned with the problem.

Such a policy statement was jointly developed during 1955 by representatives of the United States Department of Agriculture and the Executive Committee of the National Association of Commissioners, Secretaries, and Directors of Agriculture, and was entitled "Federal - State Relations in Pest Prevention and Control Activities". (Attachment 1)

"Under date of October 24 (1955), Secretary Benson accepted 'on behalf of the Department of Agriculture, this statement as a working document to be used in evaluating the extent of Federal and State participation in plant pest prevention and control activities in which the States and the Federal government have concurrent responsibilities'." (W. L. Popham, January 25, 1956).

The policy statement has received the wholehearted support and approval of the four Regional Plant Boards and of the National Plant Board.

FEDERAL-STATE RELATIONS IN PEST* PREVENTION AND CONTROL ACTIVITIES

I. Introduction

This is a statement of policy jointly developed by the United States Department of Agriculture and the appropriate agricultural agencies of the States with respect to Federal-State relations in pest prevention and control activities.

Agriculture in the United States suffers serious annual losses and added production costs because of the attacks of injurious pests. The solution of this problem demands the most effective program that can be developed by the Federal-State and local governments acting in cooperation with industry and other private agencies.

Because of their divergent nature many pest problems require Federal-State cooperation. The total of these confronting the nation includes programs (1) of Federal, (2) State and local, and (3) joint responsibilities. While an outbreak of a particular pest may be local in scope, its suppression may provide protection to other vast areas of the nation not yet infested.

Under existing State and Federal laws any pest control or eradication program within a State must be carried on under State authority.

II. Federal Responsibilities

The following are examples of responsibilities in the field of pest control that are primarily Federal:

1. Preventing the introduction of seriously injurious pests of agriculture into the United States.

2. Preventing the spread of seriously injurious pests of agriculture between the States.

3. Developing, correlating and evaluating pest information from foreign sources.

4. Cooperating with foreign countries, particularly neighboring countries in the control of crop pests to prevent their introduction into the United States.

5. Conducting pest eradication or control programs on Federal property.

*Defined as insects, plant diseases, and nematodes of economic importance.

III. State Responsibilities

The following are examples of responsibilities in the field of pest control that are primarily State:

1. Preventing the spread of seriously injurious pests of agriculture by the use of quarantines or other suitable means in the absence of Federal action.

2. Developing and administering intrastate quarantines including those which supplement interstate quarantines.

3. Providing independently or in cooperation with other States for the control of native or naturalized destructive pests normally having reached the limit of their range in this country.

IV. Joint Responsibilities

The following are examples of joint responsibilities in the field of pest control:

1. Eradicating or controlling an incipient infestation of a pest new to the United States.

2. Developing and administering programs designed to suppress or prevent interstate spread of pests new to, or not widely distributed in this country.

3. Eradicating or controlling an unforeseen emergency outbreak of major significance of a pest for which no control program has been provided.

4. Eradicating or controlling an emergency outbreak of a pest against which a control program is in progress, but which has developed in intensity and magnitude substantially beyond expectations and threatens significant losses, or will require larger expenditures at some future date if prompt action is not taken.

5. Correlating data as a guide for development of research.

6. Providing for pest surveys to determine and record the presence of pests and the extent of spread, with particular attention being given to new or potentially serious pests.

7. Developing information for dissemination to the public on the characteristics of important pests and the procedures that are available for suppression or eradication.

V. Development and Administration of Joint Programs

A. Basic Criteria

Programs of joint interest fall into two main categories--those in which the objective has been jointly determined to be eradication of the pest, and those in which it has been jointly agreed that the objective currently must be one of control and prevention of spread.

1. Eradication Programs

a. When eradication is the objective, the Federal government should provide the necessary assistance to the States to insure the elimination of all infestations in addition to engaging in surveys to determine and delineate the areas of infestation, and the inspection and certification activities associated with the enforcement of quarantines designed to prevent spread.

b. When eradication is the objective, the State Governments should provide for the necessary participation in the eradication of infestations within their respective borders, assistance in surveys to determine and delineate such areas of infestation, and the inspection and certification activities that are essential to the enforcement of intrastate quarantines designed to prevent spread.

2. Control Programs

a. When control or prevention of spread is the objective, the Federal government should provide for surveys to determine and delineate the broad areas of infestation, the enforcement of quarantines to prevent spread, and assistance to the States in the control or eradication of the pest in buffer zones and in outlying areas.

b. When control or prevention of spread is the objective, the State governments should assist in making surveys to determine and delineate the areas of infestation within their respective borders, enforcing intrastate quarantine designed to prevent spread, and conducting control activities in areas within the State where the pest is well established.

c. Control programs should be jointly re-examined frequently to be sure that the most appropriate methods and procedures are being used, and that the expenditure of Federal and State funds is fully justified. Whenever eradication is technically and economically feasible, the program should be adjusted in that direction.

B. Procedures

The following are examples of procedures involved in the development and administration of programs jointly planned and financed:

1. Joint evaluation of the problem after consultation with representatives of industry and research scientists.

2. Joint development of a work schedule for the program.

3. Joint understanding as to immediate, and, if necessary, longer range financing.

4. Joint review, periodically, of the program objectives and procedures.

5. Adjustments in program procedures and financial support as required by changing circumstances.

OBSERVATIONS ON FEDERAL-STATE REGULATORY AND CONTROL PROGRAMS BY A STATE AGENCY

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Ohio Department of Agriculture

These remarks are intended to constitute a summary of miscellaneous observations, pertaining to various Federal-State cooperative insect and plant disease regulatory and control programs. I have acquired background for these impressions through official connection with the planning and execution of such projects, principally from the State participation angle, spanning almost 40 years. No effort is exerted in this discussion to consider a comprehensive number of pest control projects or even to cover just those of major significance. No attempt is made to place an evaluation in terms of dollar returns for money expended on a given program or to compare the worthwhileness of one with others.

The philosophy, so often encountered, that what is past is past, and that there is time to think and live only in the future, is acceptable to a certain point. However, a major pest control operation which does not have its roots firmly established in the soil of past experience is doomed to failure before it starts.

It merely is hoped that by drawing attention to circumstances prevailing at a certain time, which contributed to the success or failure of a particular program or programs, some guidance may be obtained which will contribute to the progress of those yet to be initiated.

Federal-State regulatory and control programs, to which attention is directed here, are systematically planned and executed attempts, backed by law, designed to accomplish on an extensive community basis the same purposes which the individual seeks to achieve on a small scale in spraying his orchard or his garden with pesticides. Neither of these community or individual efforts hold promise of success unless the operations are founded on sound research. The term research in this instance refers not only to establishment of correct and complete information about the pest to be controlled, the host on which it preys and the efficiency of the insecticide or the fungicide employed but also to the time, method and rate of application thereof and to the adequacy of the applicator used to obtain uniform and thorough distribution. The knowledge and skill of trained operators added to well planned programs based on sound research, and backed by an informed citizenry totals a successful pest control operation. Thus the indispensibility of a smoothly functioning inter-relationship between these factors under discussion becomes self-evident.

At least two exceedingly important blessed events worthy of mention are recognized generally as major contributions to the success of regulatory and control programs, however large or small, which have been sponsored

by public agencies during the past four decades. The first was the birth of a document well known, at least in official regulatory pest control circles, as the "Principles of Plant Quarantine" and its adoption in 1931 by all Regional Plant Boards. It was composed by thinking men of wide experience and considered judgment in this field and was intended to serve as a guide in the planning and execution of projects of this nature. Its provisions have stood the test of time with only slight modification since its inception. Probably the greatest benefit derived from the unanimous acceptance and application of these principles has been the resulting general uniformity of procedures followed in case after case.

The second event was the recent birth and acceptance by all Regional Plant Boards, by the National Plant Board and by the United States Department of Agriculture of an instrument which might be called a "Federal-State Responsibility Allocation Policy," which delineates the responsibilities to be assumed by the Federal Government and by the States involved in the various Federal-State cooperative regulatory and control programs initiated and pursued from time to time. The arrival of this guide, to be used as a basis of understanding, was long overdue but now as an actuality gives promise of expediting the planning and the acceleration of the work to be done by minimizing past inequities.

In order to avert the risk of contributing to a miscarriage of justice, in treatment of this subject, I dare not fail to mention an important happening, on the other side of the ledger, which rather recently presented an alarming situation of high detrimental potential relating to the future progress of cooperative regulatory and control endeavors in this country. Reference is made to the obvious intention to de-emphasize future participation by the Federal Government in cooperative control programs as revealed by the drastic and unrealistic reduction in the federal budget for such purposes recommended by the United States Department of Agriculture for the 1955 fiscal year. This situation held the possibility of defeating or severely retarding, many major programs then in progress, with the added prospect of nullifying the value of previous state and federal investments, and of preventing the initiation of any similar future programs. Fortunately, this position, assumed by the Federal government, persisted for a relatively short time only, but much too long for the comfort of State cooperating agencies. May any such recurrence be avoided. The reversal of attitude by the Federal Government, in reference to this question, has met with spontaneous and universal acclaim by all States involved.

What are some of the influences which affect the prospects for success of plant pest or disease regulatory and control programs favorably or adversely?

Among the more significant of such influences may be mentioned --

(1) Public apathy which usually is attributable, in part at least, to a dearth of knowledge among the people involved concerning the importance of facts in reference to the programs;

(2) The value of the host crop in jeopardy -- interest is usually in direct proportion to the value of the endangered crop or crops concerned;

(3) Relative host injury potential of the insect pest or disease involved -- usually the greater the injury potential the greater the interest;

(4) Methods of natural or artificial dissemination of the pest -- the greater the number of avenues and the easier the methods of dissemination the more complex become the control problems;

(5) The amount and accuracy of pest and host research data available -- too little dependable research information can be fatal;

(6) Adequacy and availability of pesticides -- a scarcity of efficient weapons of this nature may spell defeat;

(7) Insufficient public funds to do the job -- can be and frequently is a case of too little too late;

(8) Lack of properly trained personnel -- this work could be regarded as less attractive as a vocation compared to others;

(9) Inadequate or scarce equipment -- frequently proper equipment must be developed;

(10) Conservatism or lethargy on the part of public officials with initiatory responsibilities -- timidity and procrastination can cause failure;

(11) Cost of the cure out of proportion to anticipated benefits -- in other words, the project may prove to be economically impractical;

(12) Lack of a well planned parallel extension type of effort -- an enlightened public usually is a cooperative public;

(13) Inadequate legal support -- quarantine and enforcement law loopholes must be plugged;

(14) Success or failure of a given program may set an example for others to follow -- success begets success; and

(15) Adapt the best methods of one program to others when applicable -- take advantage of the other fellow's successful experience and avoid his mistakes.

A personal appraisal in retrospect of a very few cooperative Federal-State regulatory and control programs may serve to illustrate what I mean by the influences just enumerated which have contributed to success or failure thereof. One or several of these influences can be applied readily to each program discussed.

The chestnut blight eradication campaign failure seemingly can be attributed to the lack of pertinent research data at the time it was launched. Certainly, there was a dearth of knowledge as to the method of dispersion of the pathogen; otherwise, the costly effort to arrest its spread would never have been undertaken.

One of the most outstanding examples of success of a large scale plant disease regulatory and control program is exemplified by the barberry eradication campaign designed to control the spread of black stem rust of small grain. The repeated staggering annual losses of grain for several years prior to World War I demonstrated the destructive potential of the disease.

The anticipated urgent need for more grain created by advent of the war emphasized the need for action. The magnitude of the job to be done perhaps fortunately was grossly under-estimated in advance of the beginning of the campaign even by those presumably in the best position to estimate with reasonable accuracy. Pessimism, as to the probability of success of the venture, was expressed by many including several men well grounded in plant pathology.

In the beginning there existed a decided general lack of information on the subject in the consciousness of people everywhere but a war-scared public mind was fertile ground for the seeds sowed by extension services, and cooperative response was immediate and gratifying. Collateral research phases of the problem were duly and promptly emphasized. In a relatively few years beneficial results of the effort became obvious. Continued financial support, coupled with persistence of effort, has triumphed. The proof of success of this project is written in the records in terms of reduced rust losses. Without fear of subsequent apologies, chalk this one up on the winning side of the regulatory and control ledger, even though at this moment the end is not yet in sight.

The Dutch elm disease control program, in my humble opinion, is one which merits relatively low evaluation in terms of achievement. Lack of adequate methods of controlling the responsible vectors at the time the program was started apparently was among the principal causes of failure. Seemingly, recognition of probable defeat should have been acknowledged before the expenditures involved became so exceedingly significant. There is no regret that the state regulatory agency in Ohio did not participate in this campaign to any substantial extent.

From all indications the golden nematode of potato control project, one of widespread interest and great importance, has been well managed. The impression currently is prevalent that the threat of wide dispersion of this organism has diminished due to the excellent regulatory and control work accomplished. However, due to the extreme difficulties in detecting, identifying, confining and controlling this nematode, predictions of final success should be reserved, even though long and continuous vigilance is exercised henceforth.

The gypsy moth campaign as of this date, in its overall aspect, must be considered to be a failure in spite of the expenditure of millions of dollars by Federal and State agencies in support thereof. On the other hand, in certain isolated outbreaks such as in Michigan and Pennsylvania, success has been phenomenal. Some of the principal reasons for failure from the total aspect are obvious. In the beginning years of the campaign there was a lack of adequate insecticides. When DDT, an extremely effective weapon against the gypsy moth, became available after World War II, a shortage of funds stymied progress. This might have been averted had there existed at that time the aforementioned newly born "Federal-State Responsibility Allocation Policy." Even though the proportions of this project are tremendous, prospects for eventual victory are far from hopeless. The change of attitude on the part of Federal authorities, resulting in changing the classification of this project from an attempt to contain this pest within certain limits to an endeavor to eradicate it, is inspiring. This has been responsible for greater progress last year and a substantial promise of future accelerated gains. Anticipated benefits to be derived compared to costs are equitable. Adequate weapons, such as exceptionally effective insecticides and proper dispensing equipment, are available. If public interest, sufficient to obtain continued financial support, at a high level, can be maintained the job eventually can be brought to a successful conclusion.

Had it not been for the development of a successful combination of public understanding, progressive research and persistent determination among public agencies, the Federal Japanese beetle quarantine line in all probability long since would have advanced to a point hundreds of miles west of its present location in eastern Ohio. Between 1916 and 1940, a period of only 24 years, that quarantine line advanced from New Jersey to a point into Ohio, 100 miles, at maximum, west of the Ohio-Pennsylvania line. Today, 16 years thereafter, the line has moved only 20 miles, at maximum, farther westward. A sudden decision at State level, about 1939, to spend enough money to get results or abandon all effort to control the beetle, was responsible for putting the brakes on the rapid advance of the Federal quarantine.

In 1938, the grub control prescription was 1,000 pounds of arsenate of lead per acre at an average total treating cost of $191.00 per acre. Soon thereafter, through avenues of research, the dosage was reduced to 500 pounds of lead per acre and, with lessened application costs effected, the total treating cost was reduced to $61.00 per acre. Thanks are due to the advent of DDT in 1945, usable in the treatment of soil and foliage, for the consequent further tremendous reduction of costs per acre. Now there appears on the scene an exceedingly promising insecticide for this purpose, namely, Dieldrin in granulated form.

In this pest control business, predictions are dangerous and often prove eventually to be ridiculous, but who doesn't like to indulge? I'd like to predict that the Japanese beetle eventually will become established throughout the entire nation in spite of all efforts to prevent. It will, I believe, prove to be economically important only wherein ecological influences conducive to development of this pest, and its survival, are operative at a high level. Regardless of this outlook, vigorous pursuit of the suppression campaign is justified on the basis of the interim insurance benefits which thus are provided for susceptible hosts over broad acres as yet uninfested.

This discourse has attempted to point to several influences contributing to the advancement or retardation of regulatory and control programs and to illustrate a few of such influences operative in past and current programs well known to most of us. A commercial establishment must take inventory periodically to determine which items of merchandise should be continued and which discarded for the best interests of future business. We, likewise, should take inventory of these influences which are to be avoided or overcome and which should be continued in use, encouraged and amplified. If only a few of my thoughts are translated into practice my time and yours may not have been wasted and agriculture may be the beneficiary.

For one, I am optimistic as to the future profits to be derived from efforts expended in the suppression of insect pests and plant diseases from the regulatory and control approach, as to the practicality thereof and as to the rewards which will accrue in terms of public recognition and increased future support for programs of this nature.

INDUSTRY TAKES A LOOK AT QUARANTINES

Richard P. White, Executive Vice President
American Association of Nurserymen, Inc.

Whenever a quarantine is promulgated, certain results are inevitable, quite unrelated to the biological aspects of the quarantine. These axiomatic concurrent effects should be understood early in such a conference as this, and kept in mind as the discussions develop. These impacts were recognized by inference in the "Principles of Plant Quarantine", which have stood the test of time for a generation (Principles of Plant Quarantine - 1921).

As a representative of organized business and an agricultural industry that is highly regulated by international and domestic quarantines, I consider it my assignment to set forth certain of these inevitable appendages of quarantine action.

I IMPACT ON BUSINESS

In the first place, there must be an impact on the business involved in the quarantine action. Business competition is upset. Those within a quarantined area are handicapped in maintaining a competitive position with those firms outside the quarantined area. If the quarantine is a prohibitive one, then normal competition between firms is destroyed insofar as those firms within the area are concerned.

Businesses may be destroyed in extreme cases or seriously curtailed in others, with loss or depreciation of investments, loss of job opportunities, and, of course, loss of profit.

We do not have to look far to find examples of such extreme situations. The Japanese beetle quarantine in its early days seriously upset the normal business patterns of many nursery firms. One firm engaged in a national wholesale business with a gross of approximately $9,000,000 was suddenly forced to abandon its normal outlets, to change its business overnight to a local business within a very limited trade territory, and to adjust its employment, finances, and management to a gross of $90,000. This firm never recovered.

Another example, more recent and also not far removed, was completely eliminated from a profitable sod business due to the golden nematode, even though no nematode infestations were found in the nursery. By the time due consideration could be given to this distress situation and adjustments made, the normal outlets had been completely absorbed by competitive firms.

The "Principles of Plant Quarantine" recognized this economic impact of quarantines in defining "Necessity" in two places. They state,

"3(2) The proposed quarantine must represent a necessary or desirable measure for which no other substitute, involving less interference with normal activities is available;" (underlining supplied) and again

"3(4) The economic gains expected must outweigh the cost of administration and the interference with normal activities" (underlining supplied)

II POLITICAL IMPLICATIONS

Quarantines give rise to political pressures and these must be recognized as another axiomatic repercussion of quarantine action.

Persons or firms injured by quarantine action in their pocketbooks are difficult to convince that there is a greater public interest involved than the interests of their own businesses. There is nothing abnormal about this attitude. It is a normal reaction to business adversities.

Confronted with an adverse business climate the man in business is going to attempt corrective measures, one means of which is political. Business, rightly or wrongly, felt that the New Deal Administration was "anti-business" and as a result took whatever action they deemed necessary to effect a change.

Groups of persons in the same business in voluntarily organized trade associations for their mutual benefit or protection act in the same manner. Trade Associations composed of national competitors, voluntarily organized, are the bulwark of free competition. The smallest competitor gets the same consideration and the same protection and enjoys the same services as the largest competitor for a sum which he can afford to pay.

The leadership of these business organizations determines the extent to which the public interests are considered greater than the industry interests. Today's business organizations have in general a leadership that fully recognizes the public welfare interest in all the positions it publicly takes. If quarantines and regulations can be eliminated or modified so as to protect the public welfare and at the same time result in less interference with normal business activities, then organized business leadership would be doing a disservice to his industry and to the public if it did not make sincere and honest efforts to bring about such desirable changes in a cooperative way.

The regulatory officials of both state and Federal governments are fully aware of these facts we know, as they have been with few exceptions, most cooperative with industry in my experience and observation, in working out quarantine problems so as to meet their obligations and at the same time causing as little disruption to normal business activities as possible.

III FINANCIAL CONSIDERATIONS

We all must share in paying the bill for quarantine and control activities. No person is going to pick up the tab, and any political agency that does so, is merely spending the taxpayers' tax money.

Quarantine enforcement and eradication on suppression programs cost money. Money is often hard to get from Federal or state legislators, particularly in times of general economic stress. Businessmen and the professional must objectively evaluate the risks involved, the size and importance of interests threatened, the expectation of successfully reaching the objective sought by quarantine action, the economic gains to be expected, and the hidden costs of interference with normal competition. These must be weighed against all the dollars and cents costs of enforcement of the quarantine or carrying out of eradication or suppressive measures.

Upon the outcome of this balance sheet, which cannot be hard and fast, much of which must be based on the best judgment of men with experience and maturity in such matters, depends the actions taken and also the possible successful outcome.

Quarantines, control and eradication programs should not be recommended without consideration of all these factors, since those who are responsible for public funds are proverbially critical of such expenditures. It takes solid arguments of both the professional and the businessman sometimes to convince these watchers of the public purse that a dollar spent will be a dollar saved.

IV INTERSTATE PROBLEMS

Quarantines promulgated by the Federal government with the cooperation of the states involved generally disrupt the normal flow of commodities less than a number of state quarantines, even though uniformly drafted. Words have different meanings to different persons. The same verbiage may be construed to mean different things to lawyers and enforcement personnel and may lead to different interpretations and consequently different actions.

In general, speaking for the agricultural industry I represent, whenever a plant pest involves more than one state, we would prefer Federal quarantine action drafted and enforced in cooperation with the involved states.

Conversely we would favor, in general, no Federal action of a quarantine nature for those incipient outbreaks confined within the boundaries of a single state. Cooperation between Federal and state authorities is, however, highly desirable.

In any eradication program we believe the Federal government should be a major participant since such programs are primarily aimed toward the

protection of important national resources. States involved should be substantial participants on account of their own interests, but not necessarily on an equal financial basis. Each situation, in our view, must be considered independently.

Fortunately, with our increased understanding of the depressing influence of many requirements incidental to quarantines formerly enforced by some states, the old major problem of interstate trade barriers has about disappeared. There are a few requirements of a few states still being enforced which bear the stamp of economic protection instead of biologic. Trust and confidence in each other, between regulatory officials themselves, and between regulatory officials and businessmen, has gone far in eliminating these expensive, irritating, and non-essential camp-followers to state quarantine efforts.

V INTERNATIONAL CONSIDERATIONS

Now to a few brief remarks about international considerations that arise as a result of Federal international quarantine action.

The same axiomatic business impact mentioned earlier, results whenever an international regulatory or prohibitive quarantine is promulgated or rules and regulations are prescribed. They are no different in fact or theory than those mentioned above.

However, you have government vs. government, industry vs. industry, both of which are cold, impersonable entities interested more in facts that can be computed on a calculating machine than they are in workable relationships, without risk to either.

For example, governments are more concerned about trade balances, balances of power, economic aid, international pressures, and self preservation, than they are in international quarantines, that must by their very nature suppress international trade and thus exert an influence on international trade balances, stabilization of currencies, etc.

Yet domestic industry in this country, not limited to those of agricultural nature that we deal with, has proverbially been one supporting protective tariff and other means of limiting foreign competition.

This view on the part of many manufacturing industries is changing due to prohibitive import requirements of foreign governments. The big manufacturing industries have established foreign production facilities, foreign assembly plants, and foreign sales forces. They are now in the "free trade" forces, where they were once in the "high protective tariff" camp.

Agriculture, on the other hand, cannot meet the international situation of the so-called "one world" quite as easily. Our domestic farmers cannot become international farmers. We must produce as efficiently as we can, using all aids possible under a high cost per unit, based on

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comparable costs in other lands, and produce for a domestic market or a subsidized world market.

The nursery industry has only an insignificant export market. Outright losses caused by plant pests, and the costs of control in our cultures, and the overhead and out-of-pocket expense of meeting requirements of Federal and state quarantines must be added to our costs of production and passed on to the consumer. We can stand so much of that and no more.

Consequently, we have for years supported a strong enactment of law as a first line of defense against the inadvertent importation of any more pests of foreign origin. As a part of this policy, we have supported a rigid and strict enforcement of the provisions of quarantine #37, the seed and plant quarantine, and will continue to do so.

Recent history will support such a position, despite opinions of some foreign interests to the contrary. The stronger and more efficient can this first line of protection be made, the fewer epiphytotic and epidemic plant pests will we have to contend with in the future, at great expense to the producers of food, fiber, and other commodities produced on our general and specialty farms; at great expense to the public through taxes collected by states and the Federal government, to be spent for eradication or suppression programs.

Our viewpoint on these matters is one of self-protection and also the protection of the natural resources of the country. In this day of intercontinental transportation and of biological warfare, it is also in conformance with the government's program of Civil Defense. Destruction of food and fiber by biological means is effective in the waging of war, as well as the destruction of armaments and people.

There is no basic disagreement in principle between industry and business on one hand, and the professional quarantine enforcement officer on the other, in regard to the essential biological considerations of any domestic or international quarantine. There has been and there will continue to be differences of opinion in the degree of "calculated risk" that it is desirable to assume in plant protection decrees.

The view of domestic interests, we believe, should be "no calculated risk" if it can be avoided. The resources are too great to jeopardize. There will always be a gray area of judgment as to what constitutes a calculated risk. This exists between regulatory officials themselves as well as between regulatory officials and domestic producers.

Pressures for international trade, international friendship and economic aid may be so great, however, that departure from the principle of "no calculated risk" may have to be modified in specific instances. If international economics outweighs biologic considerations, then compromises weakening the principle of "no calculated risk" should be made reluctantly and only in the absolute minimum degree.

INDUSTRY LOOKS AT PLANT PROTECTION ACTIVITIES

Donald G. Fletcher - Executive Secretary
RUST PREVENTION ASSOCIATION
Minneapolis, Minnesota

To say that industry is interested in plant protection activities as developed and carried on by State and Federal authorities may be classed as one of the understatements of our generation. Just as there is an economic and social revolution going on in every country of the globe, including our own, so is there a powerful revolution taking place in plant and animal kingdoms throughout the world. We can only hope that wise, honest, and competent men are guiding and will continue to guide the destinies of "we, the little people" in our local, State and Federal governments and through those international agencies, such as the United Nations. Aside from our votes and the pressure of public opinion, our individual influence is rather insignificant in the field of national and world affairs. However, in the plant kingdom, we, individually and collectively, can greatly influence activities affecting regulatory and control work on a local, state, national and even world basis.

Gathered here are the acknowledged leaders in the plant protection field. Add to this group the State, Federal and industrial leaders who have met or will meet at the four regional meetings, and you have a large share of the best thinking and experienced judgment found anywhere in the world on these matters. The responsibilities of this group are staggering. Formerly, the general public and industry as a whole looked to our State and Federal plant protection officials to handle all situations that involved their interests in this broad field. Unless their pocketbook or their pet flower or shrub was directly affected, few people understood or appeared to care what happened. Of course, specialized industries, such as nursery, chemical companies, seed and plant growers and farmers whose crops have been attacked by destructive insects or plant diseases, have long been aware and often active in demanding and supporting disease and insect pest control programs.

After being in the thick of this fight for many years, I believe there is an intelligent and growing body of support for the work of plant protection among all our citizens. This changed attitude has not just happened. It is the result of some trial and error experiments in the area of large scale regulatory and control activities and of careful planning in the field of public relations, education and publicity. It is my belief that no other group in government has a better understanding of how people will react and how to handle the varied reactions of American citizens to regulations and procedures prescribed by our State and Federal governments than workers in plant pest control work. I have always been thankful I have had the privilege of sitting at the feet of that Dean of Public Relations, that Hoosier Sage, who knows how to get selfish people to do things they don't want to do in the interest of the majority, and end up respecting him and the plant protection work in Indiana, namely,

Frank Wallace. It has been a privilege to be a contemporary of such outstanding men in this work as Lee Popham, Cy Boyer, John Baringer, Ernie Chambers, Thor Aamodt, and Ray Bulger.

Industry is helping, it should help more, but a better understanding of the complicated problems you face is necessary to enlist industry's support on the broadest possible scale. May I suggest a few points which I believe are important if plant protection workers and their programs are to keep and expand industry support and cooperation?

> Continue and expand a carefully planned informational and educational program through all types of media.
>
> Encourage every state and Federal plant protection employee to learn about the many phases of the work and to present a united front in support of the various programs to the public.
>
> The administrators would all do well to select a group of key people who would be visited personally and kept well informed on the programs and their operation. Then, when help is needed from high places - quicker action can usually be obtained from friends than strangers.

As I suggested before, industry for the most part is willing, in fact, expects regulatory and control administrators to anticipate needs, plan and carry out plant protection programs. Too often in the past, lethargy on the part of the public to dangers pointed out by administrators has permitted situations to get out of hand because when funds were provided, they were "too late and too little". Sometimes administrators may take a calculated risk and delay putting into operation a control or regulatory action and the pest gets a running start.

Industry wants protection from domestic and foreign pests, but when their business procedures are interfered with, and particularly if incomes are jeopardized, State and Federal officials must have sound and defendable reasons for their actions.

The results of this and similar meetings cannot help but lead to a better understanding of these problems by all concerned. Their solution requires the best judgment of all persons and industries affected. I would urge that you continue your present policy of consultation and discussion on regulatory and control problems with State, private, and Federal interests.

Domestic quarantine problems are serious and complicated enough, but when we give even superficial consideration of the problems of foreign quarantines, the possibilities are frightening. I know that Mr. E. P. Reagan, Director of the Plant Quarantine Division of the ARS, will speak at length on the subject of foreign quarantines, but I cannot help emphasizing one

phase of his work. In spite of every effort that can be made at the principal land, sea, and airports of entry into the United States by Federal and State quarantine inspectors, foreign plant diseases and insect pests have entered and will continue to enter and establish themselves in this country. The four hundred Federal inspectors and all their cooperators can only hope to delay and reduce the pests that cross our borders.

It has long been our contention that considerable expenditure of Federal funds would be advisable to study the effects of foreign plant diseases and insect pests on our crops when grown in countries of origin. Some efforts along this line are now being made in cooperation with other countries and the work of the International Plant Protection Organization is showing good results. However, only the surface has been scratched in this field and much needs to be done. All plant protection work takes time, carefully tested programs, basic and applied research, trained men and money. Speaking for the industries supporting our Association, we pledge the administrators of this work our full cooperation in the successful prosecution of this important and never-ending task.

INDUSTRY LOOKS AT COOPERATIVE PLANT PROTECTION ACTIVITIES

Harold C. Lewis, Entomologist
Sunkist Growers, Los Angeles, California

Regulatory and control activities, while primarily for protection of agricultural industry, are of benefit to both producer and consumer and thus are highly important in the welfare of our entire economy. The strong, active support by industry for these activities of providing adequate protection against the establishment of new pests, has been most evident. Industry has not only demonstrated support but also keen interest and even insistence that such protection be provided. It is also obvious that industry has a responsibility as conditions change to insist on modification and improvement of quarantine and control programs.

Industry is much concerned in having a progressive and sound program that keeps pace with the changing times. In general, we have had that... but with the rapid changes now taking place, particularly in increased trade and travel, and especially in the speed of travel, the opportunity for plant pest introduction appears to be definitely increasing. Much of our geographical isolation which has afforded us considerable protection in the past is rapidly disappearing.

The construction of modern highways from the California and Arizona borders into Mexico, where none existed only a few years ago, provides a new and direct contact with central and southern Mexico and eventually Central and South America; not only for automobile passenger traffic but also for truck movement of agricultural produce right to our southern border. This is an example of the changes taking place, with a consequent increase in hazards. The rapid development of air travel also is of concern. Obviously the problems of quarantine and control will increase in the future rather than diminish.

Agricultural industry is well aware of many of the problems confronting quarantine and regulatory officials. Support for sound protective measures by the agricultural industry in general has been most evident; in fact, support has been very instrumental in a number of projects. Several may be mentioned, referring particularly to the citrus industry.

Citrus white fly was the object of an eradication program in Northern California early this century but was not carried to a conclusion at that time. However, some years later (in 1925), at the instigation of Sunkist Growers, Inc. (then known as the California Fruit Growers Exchange), with the support of the California Agricultural Council, funds were obtained for the first year's operation to again initiate the program. The funds obtained from the legislature were matched by the citrus industry. This eradication program was carried out successfully by the California State Department of Agriculture, and at the time

was by far the largest and most outstanding such endeavor attempted against an insect pest in the state of California.

The citrus black fly control project in the State of Sonora to the south of us is another example. In this case the citrus growers of California and Arizona, believing prompt emergency measures were vital and because no Federal or State funds were immediately available, undertook their own campaign. (The purpose of this was to promptly get in motion the project which was later relinquished to the Agricultural Research Service, Mexican Fruit Fly-Citrus Black Fly project, as soon as official funds were available). This is a most unique instance of an organized growers group undertaking a spray control project in a foreign country to contain the approaching spread of a dangerous pest. Over $35,000 was spent in 1947 and 1948 in a grower-financed and grower-operated program. That this project was and is a success is due in great part to the energetic and sound management by R. S. Woglum, then Chief Entomologist, Sunkist Growers, who early appreciated the importance and urgency of the situation.

More recently the fruit, nut and vegetable industries of California and Arizona have raised money to finance small but emergency needs of the Agricultural Research Service, Mexican Fruit Fly-Citrus Black Fly project in the barrier zone of northwest Mexico. In 1954 funds were provided for a fumigation chamber at Benjamin Hill, Sonora; in 1955 a second one at Ensenada, Baja, California. During the past year additional funds were raised by these industries to provide loading and unloading platforms to expedite inspection and for water facilities at various quarantine inspection stations in Mexico. These are a few concrete instances demonstrating the keen interest, cooperation, and even insistence, that agricultural industry be adequately protected by quarantine and control activities.

In order to keep pace with the changing times and developments, it would appear:

1) Quarantine should be maintained and strengthened in every way possible and wherever feasible. Industry will definitely support this. As conditions change, we should modify and improve our quarantine procedures. Point-of-origin inspection and treatment may offer further possibilities. The operation of barrier zones, where possible, as carried on in northern Mexico, is most desirable. In this case the operation of the barrier zone to prevent natural spread, as a first line of defense, is vital in keeping pests such as the Mexican fruit fly and citrus black fly from reaching our border. But even so, inspection along the border at points of entry, as a second line of defense, should not be neglected. Industry has been concerned about this along our southern border, as some of you well know. The consequences are too serious and the hazards too great to neglect any protection that is practical.

2) Much more consideration should be given to a third line of defense...an integrated, coordinated, and fully staffed detection program. (There have been in the past various survey, scouting and inspection programs). Appreciating the need for some such program, the California State Department of Agriculture, since 1947, has maintained a detection or survey program for a number of pests, in which they have been assisted by the various counties. However, by whatever name it might be called, some such program needs to be perfected and organized on a permanent basis with the specific responsibility of surveying, scouting, or detecting for dangerous pests not already established; including insects, mites, plant diseases, and weeds. This should include county, state, and Federal agencies working on a cooperative basis.

To point out the value of such an inspection or detection program, it might be well to refer to the experience in eradication of red scale on citrus. For many years various geographical districts in our citrus areas have organized on a voluntary or legal basis to prevent the establishment of red scale within the district. Some of these districts are operating very successfully but others have failed. From the experience gained over the years it is clearly evident that the operation of a permanent staff of trained inspectors, who really know how to detect for red scale, is fundamental to the success of any such eradication program. Inspectors in some cases are even required to periodically submit to an eye or vision test given by a member of the medical profession. On the other hand, casual, temporary or seasonal inspection has proved inadequate. This is merely to point out the difference in efficiency between a permanent program with trained and competent personnel as contrasted to one of seasonal or an emergency nature.

If we are to avoid the establishment of new and dangerous pests or escape the costs of expensive eradication campaigns, we must consider expanding our detection program and then maintain a high level of efficiency in detection methods!

3) Further consideration should be given to placing trained men in foreign countries for survey and study of pests not already established in this country. This would not only be of great benefit to the operation of our own regulatory and control programs, but to the foreign countries as well. This, it appears, would be a very sound form of foreign aid. Obviously the Federal government has a major responsibility of furnishing the various states with a knowledge of dangerous pests including their habits and possible means of introduction.

4) The importance of regulatory and control programs justifies the employment of well trained and highly competent personnel. Means should be found of providing the incentive for attracting such personnel.

We can ill afford to suffer additional costs or a lowering of the quality of fruit because of the establishment of new pests. The cost of production of many of our crops is high and probably going higher. A considerable part of that cost of production is involved in the control of insects, mites and plant diseases. The citrus industry in California spends close to $10,000,000 annually (or about one-fifth of the total cost of production) to control these established pests. In addition, there are considerable losses in spite of treatment and real but intangible losses from viruses and other plant diseases, and, even more important, possible reduction in fruit quality.

The importance of adequate regulatory and control programs needs to be continually stressed and as conditions change these programs must be modified and improved. We must be alert to the needs of industry to maintain the production of only the highest quality of fruit and other commodities.

RESEARCH SUPPORT FOR CONTROL AND REGULATORY PROGRAMS

C. H. Hoffman
Entomology Research Division
Agricultural Research Service
U. S. Department of Agriculture

One of the most important entomological needs today is close cooperation and coordination between the research and control and regulatory programs underway throughout the country. In spite of many safeguards to prevent the introduction and spread of insects in the United States, a number of species have not only reached our shores but have become established and are causing economic damage. Sometimes native species that have been harmless suddenly become destructive. Regardless of its origin, if an insect causes great damage, growers will seek help, and the research entomologist will be expected to furnish information on its control.

Obviously it is not possible to furnish adequate control suggestions for each of the estimated 8,000 destructive insects that are competing for our food and fiber in this country. However, with marked improvements in insect control year by year, it has been possible to do a reasonable job in controlling these pests. Those closely associated with research fully realize the many difficulties in meeting the ultimate aim of providing safe and effective measures which can be used by individual growers or by action agencies faced with undertaking control or eradication programs. The over-all research job has been so large in comparison with available funds and personnel that only the most important insects have been studied even in moderate detail. When a new or relatively unknown insect pest suddenly causes important damage on a particular crop, there usually is pressure for a government-sponsored control or eradication campaign. Those in charge of these programs may run into many difficulties if it is an insect upon which research data are lacking, and particularly if funds for research are not available at the same time as those for control. Research agencies must maintain a certain degree of flexibility and endeavor to meet the control agency's needs insofar as possible. However, a considerable investment is often lost when other important research is curtailed to meet a particular emergency problem.

The research effort needed varies greatly, depending on the insect involved and how much of previous research can be immediately utilized. Sometimes it has taken years of study by both research and control workers to develop a procedure that was satisfactory either for carrying out a regulatory program or for achieving direct control in areas where introduced pests have become established.

For many years entomologists, insecticide chemists, plant pathologists, wildlife specialists, and other scientists with private organizations, industry, the States, and the Federal government, have cooperated in studies

to develop safe and effective measures to control destructive insects. The results have been outstanding, and the rest of the world depends greatly on this country for new developments. Those of us closest to these insect problems realize some of the difficulties ahead, including insecticide residues and the resistance of insects to insecticides that formerly were outstandingly effective. Nevertheless, excellent progress has been made in meeting insect problems both in ordinary times and during national emergencies. Some of the information that has been obtained through the techniques developed in meeting day-to-day problems can very easily be translated into effective Civil Defense programs when and where required. However, it may be that some of us are not too well acquainted with present insect control and regulatory programs in this country and of the research that supports such programs. Let us therefore consider briefly some examples of the research information and research services that are needed by officials in charge of extensive control and regulatory programs on destructive insects such as grasshoppers, Morman crickets, pink bollworm, Japanese beetle, European chafer, gypsy moth, Mediterranean fruit fly, oriental fruit fly, melon fly, Mexican fruit fly, citrus black fly, white-fringed beetle, sweetpotato weevil, and khapra beetle.

Insect Detection.--Insect taxonomists throughout the country have been of special service during normal and emergency times with respect to the detection of important or potentially important pests. Ordinarily it takes specialists with experience to detect new or little known species which superficially may look like common pests. Members of our Insect Identification and Parasite Introduction Section receive each year a large amount of material from the Plant Quarantine Division, the Plant Pest Control Division, other Federal agencies outside the Department of Agriculture, States, Territories, and private individuals. Most of this material is of rather routine nature, but occasionally something of consequence turns up. Some of you will recall the discovery a number of years ago of Allodermanyssus sanguineus on Long Island, New York, as the result of Charles Pomerantz' interest in an outbreak of a disease that was eventually called rickettsial pox. The identification of these mites was made in the Department, and their potential as a disease vector pointed out to Mr. Pomerantz and to the public health officer assigned to the investigation.

Identification and Classification Studies.--Insect identification and associated activities relating to regulatory programs are both direct through the rendering of services and indirect through the support of other research programs that are in themselves concerned with regulatory and control activities. Expert identification work requires personnel with good basic training and with much experience, including field work. It is often not fully realized that careful taxonomic research must precede identification. Even with insect groups that have been studied widely the standards of work and ideas as to limits of species and genera change with increasing knowledge, so that continued review and evaluation of previous work is necessary if the quality of identifications is to be high. The taxonomist observes differences and likenesses in the material

available and, on the basis of these observed morphological characters together with his knowledge of biology and distribution, develops arrangements that reflect the presumed phylogeny of the group. Laborious examination of hundreds or thousands of specimens from many areas may be required. This must be repeated for all different stages and both sexes of the species being studied. Frequently satisfactory classifications are evolved for different stages or sexes even though it is not possible to associate the sexes that belong together or the immature stages with the adults. Such associations must await further biological studies in the field. (See figure 1, page 59.)

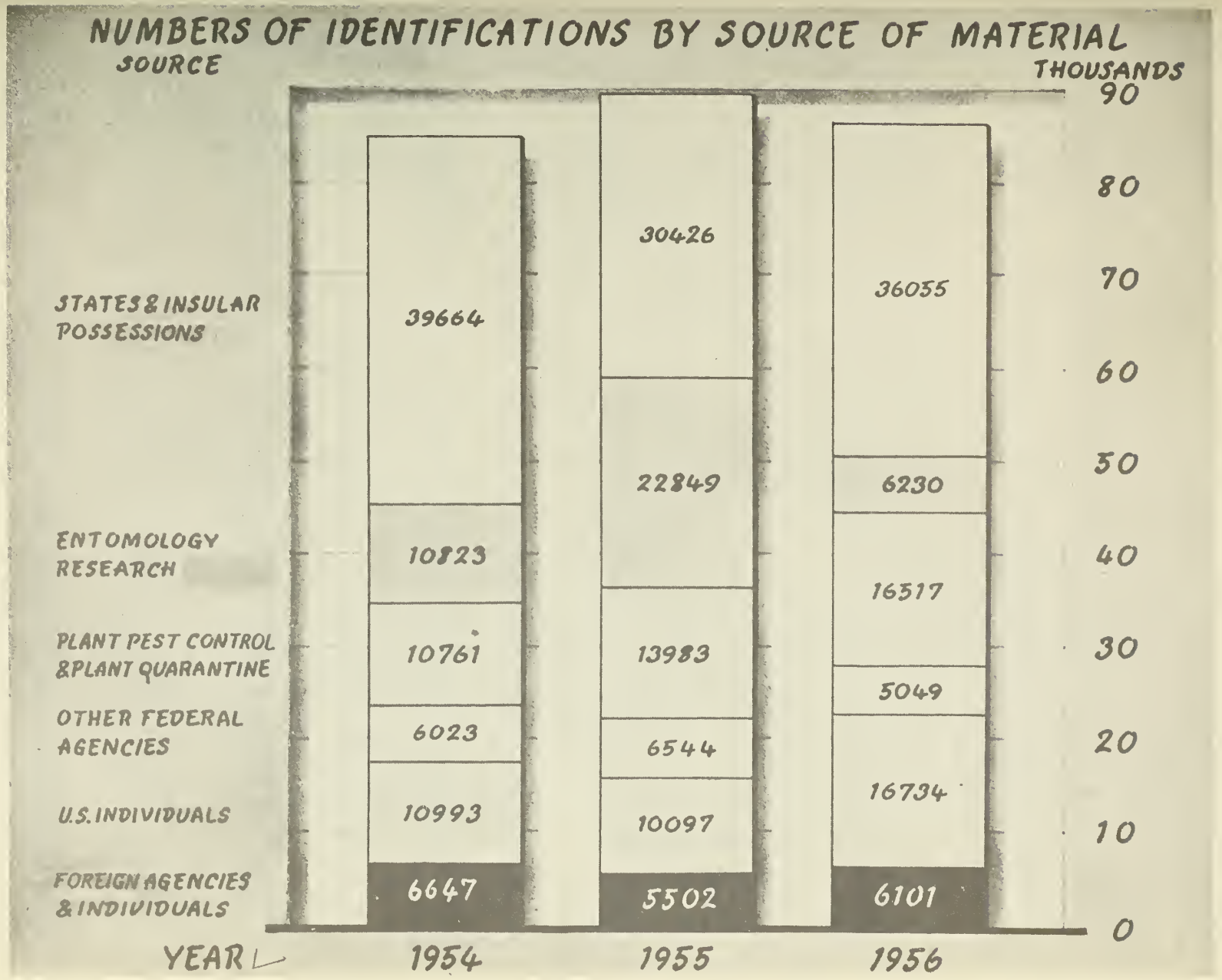
The taxonomic unit of our Division is an important source of information concerning foreign pests of importance. It supports the activities of the Plant Quarantine Division of the Department by supplying not only identifications, but pertinent information on the distribution, biology, and potential importance of intercepted insects. In turn, a great deal of information on the distribution and host range of foreign pests has been accumulated by the interception and identification of insects taken from imported plant material.

Taxonomists also render assistance to the Plant Quarantine Division, which administers the Insect Pest Act governing the importation and interstate movement of insect pests. This covers the shipment of living insects by research workers, amateur collectors, fish bait distributors, etc. Taxonomists and other research personnel make recommendations as to whether the entry or movement of various species should be authorized.

Our Division also assists the Plant Quarantine Division with its in-service inspectors' training program. The men at the ports have been encouraged to learn to recognize the insects they intercept, and often they have been able to detect dangerous new pests and take prompt safeguard measures. Taxonomists have given assistance by furnishing information on different economic groups, notes on identifying characters, and by returning identified specimens for port collections. As a result of these programs, a number of inspectors have become so proficient in recognizing certain species that they have been authorized to identify them at the ports.

From time to time taxonomists are detailed to special emergency projects. For example, R. H. Foote, a specialist in the Diptera, was assigned to assist State and Federal workers on the Medfly eradication program. He helped in working out a set of instructions to field inspectors for the submission of specimens, in issuing a daily infestation report, and in training workers to identify adults and larvae of the Medfly. He found that there was a great need for information on the identity of larval stages of many flies infesting fruits and vegetables. Because of the abundance of larval material, Dr. Foote was able to rear about 16 species of scavenger and fruit fly larvae to the adult stage and to preserve associated larvae with known adults for future study.

There is need for the collection and storage of data, and a quick way to retrieve them, on insects from all parts of the world, so that if an introduced insect is found its distribution, life history, and probable


NUMBERS OF IDENTIFICATIONS BY SOURCE OF MATERIAL
SOURCE
THOUSANDS
90
80
70
60
50
40
30
20
10
0
STATES & INSULAR POSSESSIONS
ENTOMOLOGY RESEARCH
PLANT PEST CONTROL & PLANT QUARANTINE
OTHER FEDERAL AGENCIES
U.S. INDIVIDUALS
FOREIGN AGENCIES & INDIVIDUALS
39664
10823
10761
6023
10993
6647
30426
22849
13983
6544
10097
5502
36035
6230
16517
5049
16734
6101
YEAR
1954
1955
1956

damage under different climatic conditions can be learned. I might mention that the Department has over 3 million cards bearing information on different insects, but they cannot be used to maximum advantage because the data have not been recorded in such a way as to be sorted by machine. Taxonomic entomologists are dependent on the literature, including catalogues of various sorts and adequate reference collections of insects. The latter must include material of both sexes and different stages in sufficient series to show ranges of variation. Whenever possible, institutions should purchase notable collections whenever they become available, in order that entomologists throughout the country will have the advantage of such essential working tools.

Much basic classification work needs to be undertaken so that economic species can be recognized. In 1953, when the khapra beetle (Trogoderma granarium Everts) was first found, its economic significance as a stored-grain pest was not suspected. Otherwise, instead of being regarded as just another of several species of Trogoderma already associated with stored grain, specimens might have been sent in for identification back in 1946 and steps might have been taken to control it before spreading to other areas. Taxonomists have rendered control and regulatory agencies much needed service in identifying adult and larval material taken in surveys, since the khapra beetle is difficult to separate from other species in the genus. Recently the Department has obtained the help of R. S. Beal, Jr., who recently prepared a monograph on the genus Trogoderma, to undertake further studies on dermestids. He will collect and make observations on different species in the field and collaborate with others in setting up supplemental ecological, biological, and genetic studies. Such studies should provide additional information on the identification of different species and an evaluation of those that are of most economic importance.

Development and Use of Survey Techniques.--Vital to the success of any control or eradication program is the determination of the location and extent of infested areas, the intensity of infestation, and the effectiveness of control or eradication measures. Visual inspection is one way to accomplish those ends, but it is often costly and not entirely satisfactory. Effective attractants, either of natural origin or synthesized in the laboratory, exposed in suitable traps properly located may save much in operation costs and are often far more effective than visual inspection in locating light infestations. Bait traps afford a continuous check of an area which is not practical with visual inspection.

Research has not neglected the need for survey tools for pests of quarantine or control interest either to discover or delimit infestations or to evaluate control efforts. Plant pest control and regulatory organizations depend upon such tools for the operation of many of their projects.

Japanese Beetle.--Many of you are familiar with Japanese beetle traps--small yellow metal funnels fitted with a baffle, a container for the bait, and another container to retain captured beetles. Baited with a

geraniol-eugenol mixture and set out on standards in open, sunny areas, they are very effective in revealing the presence of beetles. The bait, style and color of the trap, and the method or position of placement, all of which contribute to the usefulness of the trap, are the result of careful research.

Mediterranean Fruit Fly.--The current Medfly eradication program in Florida is a good example of the importance of bait traps to the success of such programs. Just before that fruit fly was discovered in Florida in April 1956, oil of angelica seed was found much more attractive to the male flies than any previously known attractant. It was soon put to use by the Plant Pest Control Division and the Florida Department of Agriculture, and has been depended upon for the discovery of infestations, determining the need for insecticide applications, and for measuring the effectiveness of such applications. Since the attractiveness of angelica seed oil varied between lots and the material could easily be diluted or adulterated, samples of each lot were bioassayed by research entomologists in Hawaii and checked by Division chemists at Beltsville. Several lots were found unattractive to the fruit fly and were rejected. The use of such lots in key situations in Florida could have been extremely harmful to the success of the campaign. As the limited supply of angelica seed oil neared exhaustion, further research led to discovery of a synthetic attractant, the isopropyl ester of 6-methyl-3-cyclohexene-1-carboxylic acid. Through the cooperation of industry, this material was available to the control project in time to be employed as a satisfactory substitute for angelica seed oil late in 1956, before the world supply of the oil was almost exhausted.

In order to use baits effectively, suitable traps must be available in which to expose them. There is need for research with traps as well as with baits. For years bell-shaped glass traps with an open, invaginated bottom have been depended upon for exposing fruit fly baits. Such traps are available only on special order, are subject to breakage, and are expensive. They were placed in use at the start of the current Medfly program in Florida. Here again research contributed to the success of that program. L. F. Steiner, entomologist in charge of the chemical-control project on fruit flies in Hawaii and assigned as a technical advisor to the control project in Florida, soon developed a cheaper, more easily operated trap made of plastic that was promptly put to use. About 50,000 have now been procured and placed in service at an estimated saving of about $1.30 in the initial cost of each trap and 50 cents per week in manpower operating costs. (See figure 2, page 62.)

Fig. 2. Plastic fruit fly trap made from refrigerator freezer jar and polystyrene tubing. It is about $5\frac{1}{2}$ inches in length and $4\frac{1}{4}$ inches in diameter. As pictured, it is equipped with 3 wicks for using different kinds of chemical lures simultaneously. When baited with angelica seed oil alone, only the smallest wick is needed.

Most bait materials are specific for a particular pest, but work now underway in Hawaii indicates that it may be possible to incorporate specific attractants for more than one pest in a single trap. If this research is successful, it will be possible to include in a single trap the most effective attractants for the oriental, melon, and Mediterranean fruit flies.

Other Fruit Flies.--Another outstanding example of the development of a synthetic attractant is methyl eugenol as a lure for the male oriental fruit fly. An additional timely discovery was of anisyl acetone as an attractant for the male melon fly and its recent use in detection surveys in California. Despite the fact that baits are available for most fruit flies, better ones are needed, particularly ones attractive to both sexes of the melon, Mexican, and Mediterranean fruit flies. Spot and quantitative type screening of candidate materials against all species continues in Hawaii and Mexico, and field tests will follow as developments warrant.

Gypsy Moth.--The female gypsy moth produces a powerful attractant to lure the male for mating. This attractant has been employed in traps for several years to detect this pest in woodland and forest areas. It is obtained by collecting female pupae in the field, allowing the moths to emerge, and then clipping the last few segments of the abdomen from each moth. The clippings are extracted with an organic solvent, the extract is concentrated, and the product is hydrogenated. Hydrogenation stabilizes the attractant so that it may be used years later without appreciable loss of activity. Obtaining this sex attractant is costly, so that chemists of the Department are now attempting to isolate and identify the attractive principle. In spite of over a decade of research work its identity has not been established. Once the chemical structure is known an attempt to synthesize it or a similarly attractive compound will be made.

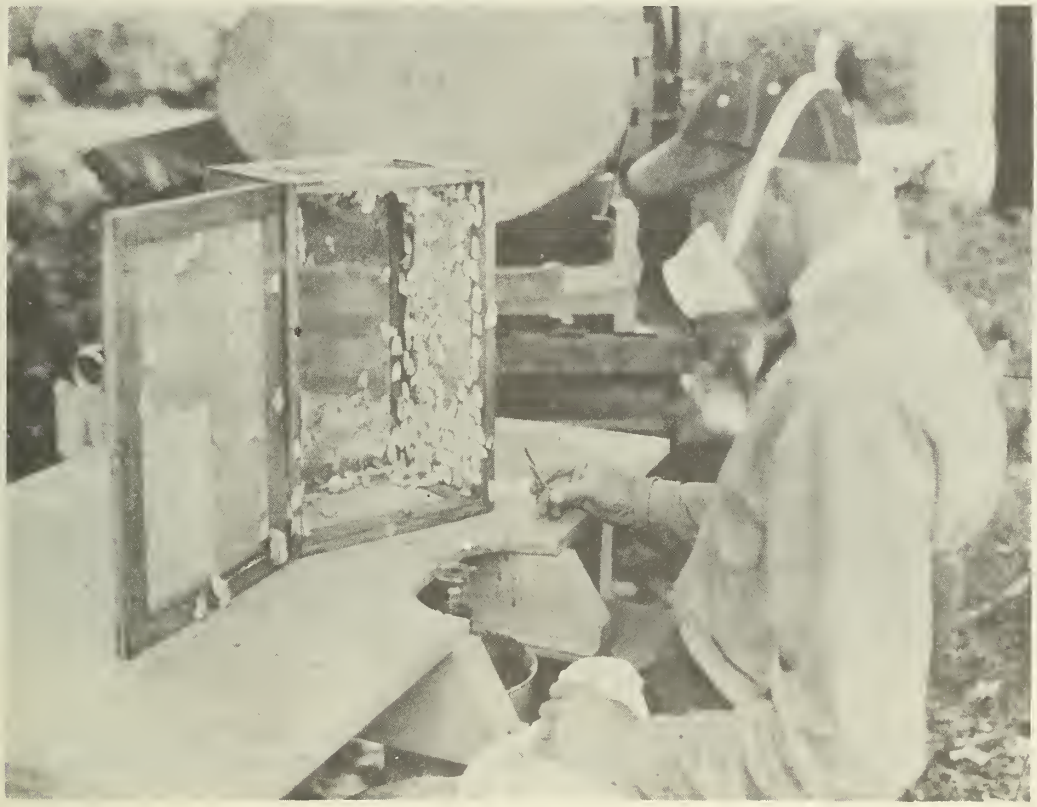


Fig. 3. Close-up of aging cage with man ready to begin clipping the last few abdominal segments of female moths to obtain sex attractant. Some men prefer to work outdoors because the hairs of the moths are irritating.

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Fig. 4. Gypsy moth trap disassembled, showing filter paper cartridge impregnated with sex attractant, and Tanglefoot-coated sheet of waxed paper to trap incoming male gypsy moths. Trap is size of large fruit-juice can.

Effects of Insecticides on Faunas of Forests and Streams.--In 1944 it was demonstrated that the aerial application of DDT to forests was an effective way to control important defoliating insects, including the spruce budworm and the gypsy moth. The discovery that control could be obtained with a small amount of DDT per acre pointed to the feasibility of its use in airplanes against forest pests over large and inaccessible areas, where control had previously been impractical. However, the toxicity of DDT to insects and some animals raised the question as to damage it might do to the general faunas of forests and streams.

Investigations were started in 1945 and continued for about five years in areas being treated by Federal and State control workers in Pennsylvania to eradicate the gypsy moth. To obtain a reliable measure of the effect of DDT on insect populations, several sampling methods were used shortly before the time of spraying and at intervals afterwards. These included the use of standard insect nets, sticky trap boards and small quadrats to estimate terrestrial insect populations. The immediate kill of many different kinds of insects was ascertained by placing trays beneath the canopy of trees and in open areas. Fly traps baited with stale beer were

attractive to many species and large collections were made. A portable light trap, with an argon-mercury discharge tube which emitted a constant but dim blue light, proved very effective. Modified Berlese funnels were used to capture the fauna of litter, leaf mold, and organic soil. These funnels have also been used elsewhere to determine the kinds and abundance of soil insects attacking various crops. All dosages caused an almost immediate and pronounced effect on many species of insects. The residual toxicity of DDT at 1 pound per acre lasted for about a week, and that of the 5-pound dosage was severe after 6 weeks, with little recovery in the fauna until after 3 months. A single application of DDT at 1 pound per acre was ample to eradicate the gypsy moth and did not cause much damage to terrestrial insects and no damage to birds. Since there was damage to aquatic insects, additional studies were made of the effects of spraying on the fauna of ponds, lakes, streams and rivers.

Fig. 5. Portable insect light trap with agron-mercury discharge tube powered by automobile storage battery.

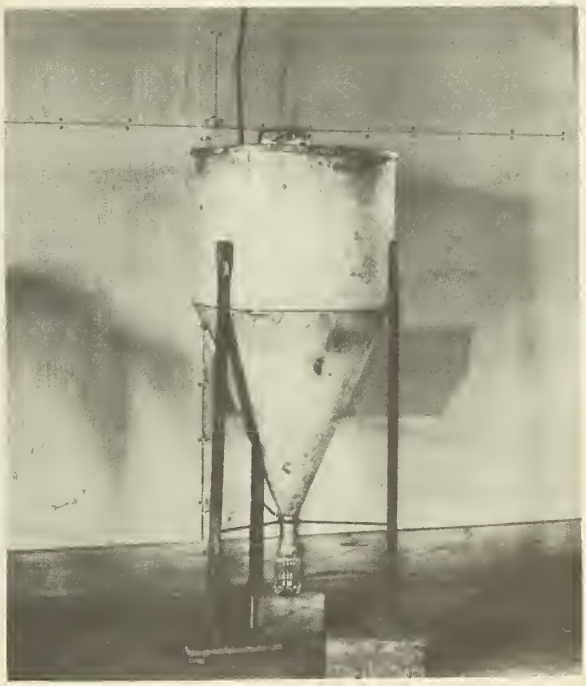

Fig. 6. Modified Berlese funnel to capture litter and leaf mold organisms.

Much of the early work was done on ponds and 1- to 3-mile sections of streams where effects of the spraying on both bottom fauna and fish were studied. At the Federal Fish and Wildlife Service fish hatchery at Leetown, West Virginia, many DDT formulations and dosages were tested against different sizes and species of fish in concrete and mud-bottom ponds. Weirs were utilized to capture affected and killed fish as they floated downstream. The weirs had to be manned for several weeks after the spray was applied and the stream banks patrolled in order to get the best measure possible of the total effects of the spray. Live boxes stocked with known numbers and kinds of fish were also used. On each treated stream filter papers were placed on supports at intervals across the stream at different locations to catch the spray. These papers were analyzed by our chemists to determine the amount of DDT reaching the water. Both before and after spraying, samples of bottom insects were taken with a square-root sampler. Only riffle areas were sampled, and the insects taken were preserved in alcohol for later sorting, identification, and counting.

In general, where DDT was used in oil solution at the 1-pound dosage there was a 90-percent loss of invertebrates at the lowest downstream station sampled, which was the maximum effect. When a DDT suspension was used the loss was only 70 percent.

The most extensive tests were made on two watersheds totaling 52,000 acres near Wilkes-Barre, Pennsylvania, sprayed with 1 pound of DDT per acre during May and June 1948 to control the gypsy moth. The insecticide rapidly diminished the numbers of insects in the bottom of the streams, but none of the 14 stations in the treated area were completely depopulated and losses at a few stations were small. The trend toward repopulation was evident two months after application of the DDT, and by autumn, except for certain caddis flies, the samples revealed ordinary numbers of bottom insects.

Several kinds of fish of various sizes were killed by spray or spray drift on ponds, lakes, or streams in Pennsylvania. The DDT spray was carried downstream and the effects seemed to be cumulative. In well-sprayed areas fish in shallow ponds were greatly reduced or eliminated. Relatively few fish were killed in either the lakes or the streams on these two watersheds, but in some locations only spray drift was involved. In one stream, various fishes were killed over a period of one month, but the loss was small in comparison with the total population. Information of the effects of sprays on fish and wildlife, and on the insects that serve as their food, is important to control organizations, who must weigh such losses due to a particular treatment against the advantages of controlling or eradicating a serious insect in order to save crops. Much research remains to be done to determine the total effects of different formulations and dosages of insecticides, especially new ones that have followed DDT, which are likely to be used widely in future insect control programs.

Bioclimatic Cabinets as a Research Tool.--Following their use in Hawaii for studies on several fruit flies, especially designed cabinets were set up at Brownsville, Texas, to determine the effect of simulated climatic

conditions of any desired locality on the Mexican fruit fly and the pink bollworm. With these cabinets, studies are made of the ability of the insects to develop and reproduce under various conditions of temperature, humidity, and light when adequate food, water, and ovipositional materials are in constant supply. The climate for a complete year for a particular locality can be reproduced in one of these cabinets, and some idea gained as to the possible range and chance of survival if the species were introduced into uninfested areas.

Examples of Research Service and Studies on Methods of Insect Control to Meet Action Agency Needs.--The discovery of the remarkable effectiveness of DDT for control of the gypsy moth and other forest defoliators represented a tremendous advance over the older days, when lead arsenate was used in spraying and miles of hose lines were taken into the woods in efforts to stop the gypsy moth. Research must be a more or less continuous process, if the best measures are developed for controlling our major pests. It is true that adjustments must be made to meet new outbreaks of concern to control officials, but sight should not be lost of current research advancements which may be applied to pests not considered heretofore amenable to economic control. Let us review some examples of different types of research that have been or may be productive in meeting certain needs of control campaigns.

Mechanical Control.--A new type of cotton stalk shredder appears promising for pink bollworm control. The machine manufactured for cutting and shredding silage has proved more effective than conventional cotton shredders. The new type shredder caused pink bollworm mortality of approximately 78 percent compared with 45 percent for the conventional shredder. It operates in a beater fashion similar to a hammermill and provides sufficient suction to lift the shredded material, including almost all the debris on the soil surface, and blow it through the housing at high velocity.

Chemical Control.--The development by research of effective insecticides that may be applied by regulatory personnel without undue hazard to themselves and to other interests, has been outstanding.

As potent new insecticides become available, research is necessary to determine what formulations, dosages, and schedules of application are most effective against different pests. This is especially important for species subject to control or eradication programs. Without an effective treatment and a practical method of application there can be no program.

Formulations.--Through close cooperation of chemists and entomologists, insecticide formulations can be "tailor-made" to meet specific needs in control programs. An example is the ethylene dibromide emulsion developed for control of the Black Hills beetle and the Englemann spruce beetle, serious pests in western forests. The ruggedness of the terrain makes it difficult and costly to transport insecticides to the infested areas. Oil solutions of orthodichlorobenzene previously used required the transportation into the forest of large quantities of oil by hand, pack animals,

or jeep. The new emulsion permits the use of water as the chief carrier of the toxicant, which is available in most of the forested areas. Only relatively small volumes of emulsion concentrate now must be hauled in, and this material is then diluted with water at the treatment site.

Sometimes formulations are needed that can be used or stored under extremes of weather conditions. Very low temperatures, for example, may cause the crystallization of active constituents from solution and subsequent difficulty in getting them redissolved. Quick, low-temperature laboratory tests have been set up for screening formulations for such purposes, and long-term storage tests are carried on at Mt. Washington, New Hampshire, where various insecticide formulations are kept for a period of years and periodically examined. The information obtained has been utilized in the development of suitable solvents for DDT spray formulations for control of the spruce budworm under low-temperature conditions encountered in Canada.

Analytical services.--Essential chemical analytical services are often provided for control and quarantine programs. One aspect of this is the analysis of insecticide materials to be applied, to ensure that the ingredients meet the specified standards as to identity and concentration. For example, the Forest Service has been assisted in its procurement of million-gallon quantities of DDT spray for spruce budworm control by the analysis of the raw materials and finished spray and by inspection of methods of formulating at the contractors' plants.

In connection with the Japanese beetle quarantine, periodic chemical analysis of treated nursery soils is relied upon to determine whether levels of DDT or chlordane present meet the quarantine requirements or if retreatment is necessary.

In the development of soil treatments for control of the white-fringed beetle, numerous chemical analyses have been made of soils from pot tests.

Mediterranean fruit fly.--Fortunately, when the Medfly was found in Florida, there was available an effective spray treatment developed through continuing research in Hawaii. The now well-known protein hydrolysate-malathion bait spray developed for the oriental fruit fly was equally effective for controlling both the Medfly and the melon fly. By December 31, 1956, more than 770,000 acres in Florida had been treated one or more times with bait sprays and only 38,055 acres were still under treatment.

The quantities of bait materials needed at the height of the Medfly eradication program in Florida were so great that there were times when they had to be stretched and supplemented. Then the recommendations of the consulting research entomologists were depended upon to determine what reductions in dosage or coverage or modifications in formulation could be made without jeopardizing the program. Here, too, continuing tests of bait materials in Hawaii made it possible to recommend a satisfactory

substitute for the sauce base No. 2 in the formulation when it was needed. The substitute formulation containing 60 percent of sauce base and 40 percent of corn steep liquor appears to be as effective as the sauce base alone.

Fig. 7. Applying semi-concentrate bait spray with conventional high-pressure sprayer through fixed booms with on-off controls operated from cab by driver. Usually only one side of each tree row is sprayed, the driver taking every other middle row and covering 20 to 40 acres per hour.

The Medfly and other fruit flies spend part of their lives in the soil. Preliminary work with soil insecticides for their control indicates that such treatments will be only partially effective but worth while for suppressing populations. Endrin appears outstanding, but it may be hazardous for general use. Dieldrin and heptachlor have both been used in the Mediterranean fruit fly campaign in Florida, but recent comparative tests in Hawaii show dieldrin to be highly effective against that pest for a longer time than heptachlor. Much more research must be done to obtain the information needed by control agencies for sound and effective use of soil insecticides in their fruit fly control programs.

Mexican Fruit Fly.--The Mexican fruit fly is a serious pest of many crops in Mexico. When it was found in northwestern Mexico and southern California in 1954, it became the subject of an intensive control program by the California Department of Agriculture and the Plant Pest Control Division. The best treatment known at that time was a tartar emetic-sugar bait spray, but it was not entirely satisfactory. Research by the Fruit Insects Section's Mexico City laboratory, showed that the malathion-protein hydrolysate bait spray developed in Hawaii was better, and it was promptly substituted for the tartar emetic-sugar formulation. Recent work indicates that malathion or methoxychlor, alone or in combination may be superior to the bait spray.

Japanese Beetle.--Suppression of incipient infestations of the Japanese beetle, particularly along highways where traffic moves to uninfested areas, by spraying host plants has long been a standard practice to reduce the hazard of spread. Before 1943 no insecticide had been found that destroyed the beetles on the plants and then remained effective for long thereafter. Lead arsenate killed some beetles but acted more as a repellent. Only when DDT became available was it possible to destroy adult beetles for any worth-while length of time following application. Now DDT sprays are used to suppress beetle populations wherever it is desirable and practicable to reduce the hazard of spread. For many years the Plant Pest Control Division used lead arsenate as a soil treatment at 500 to 1000 pounds per acre for eradicating incipient infestations of the Japanese beetle. As a result of continuing research and the availability of new materials, lead arsenate was superseded by DDT at only 25 pounds per acre, and then by chlordane at 10 pounds and dieldrin at 3 pounds. Toxaphene, aldrin, and heptachlor at low dosages are also effective. Now the control agencies have a choice of various materials, all superior to lead arsenate in one or more respects. Similar treatments at slightly higher dosages can also be used against the European chafer.

White-fringed Beetles.--The primary purpose of the white-fringed research program has been to develop effective and economical methods of control and procedures to prevent spread of the insect. Since the advent of the chlorianted hydrocarbon insecticides, control has been greatly simplified and improved and cheaper. Aldrin, chlordane, DDT, dieldrin, and heptachlor, when mixed with the soil, are effective against the larvae for seven years or more. Surface treatments of DDT and dieldrin on noncultivated land give good control for several years.

Effective control measures that have been applied to thousands of acres, have greatly reduced white-fringed beetle populations. These reductions have decreased the rate of spread and greatly lessened the regulatory problems involving certain field crops. A number of field crops are now certified for movement on the basis of soil treatments. Nursery stock, potted plants, and transplants are certified for movement from the quarantine area on the basis of treatments with DDT or chlordane. The soil treatments require less manpower for supervision than fumigation, and provide a safe treatment for a larger number of plant varieties.

Grasshoppers.--Research on grasshoppers has led the way to a continuous improvement in control of these destructive insects. Wet baits containing sodium arsenite were recommended for more than half a century. In the early forties research demonstrated that sodium fluosilicate bait was superior to sodium arsenite bait, less toxic to handle, and also extremely distasteful to cows, sheep, and horses.

From 1946 to 1950 tests were made to determine the effectiveness of chlorinated hydrocarbons as a substitute for sodium fluosilicate, and about the same time dry bran baits were developed. The dry bait had several advantages over the wet bait. It could be spread without regard to feeding periods of grasshoppers. In good weather the bran flakes would remain effective for days. It was easier to mix and could be stored for months. It could be scattered more evenly from an airplane and weighed only half as much as wet bait.

Even with these advantages dry baits were not always successful. If grasshoppers did not eat the bait (as was the case with some species), they were not killed and often it was necessary to repeat the baiting the next year.

The development of the chlorinated hydrocarbon sprays solved many of these problems. Grasshoppers have little chance to survive the new sprays which kill by both contact and ingestion. With only a few ounces of toxicant per acre control by sprays usually reaches 95 percent or better. Such kills give complete protection of crops, and if the insecticides are applied before eggs are laid, no further control will be needed for several years unless grasshoppers move in from untreated land.

During this development of baits and sprays there has been a continuous improvement in the efficiency of application.

Thus as a result of research, grasshoppers can be economically controlled on ranges in the West where at one time control was impractical. Savings have amounted to millions of dollars, not only in the reduction in damage but in the lower cost of application.

In connection with the use of chlorinated hydrocarbon insecticides there arises the problem of residues on treated crops and insecticide storage in the fat of animals consuming forage that has been sprayed. A biopsy technique is used to obtain samples of fat for quantitative chemical analysis. Periodic sampling of the same animals will give a rather precise picture of the persistence of the insecticide in the fat. The amounts are correlated with the original insecticide applications. Such information is useful to delimit the time interval between last treatment and marketing to minimize residues and to aid in the establishment of tolerances.

Mormon Cricket.--Mormon crickets have been a periodic scourge and persistent threat to agriculture in Intermountain and Far-Western States. Measures to control the migrating bands have evolved as rapidly as

research has led the way. Barriers were only partially successful, and sodium arsenite dust was expensive and dangerous to the operator, to livestock, and to green plants.

Although mixtures of bran or steam-rolled wheat and sodium fluosilicate are still recommended, sodium fluosilicate in baits has been largely replaced with aldrin, chlordane, heptachlor, or toxaphene. These chlorinated hydrocarbons can be used in dry baits, which are especially suitable for application with aircraft or ground dusters. Research had also resulted in improved methods of mixing and spreading the bait.

Khapra Beetle.--The khapra beetle, a serious pest of stored grain and seeds in several southwestern States, is an insect that State and Federal authorities are endeavoring to eradicate through fumigation and other control measures. Because the insect hides away in cracks and crannies in storage areas, contact sprays have proved ineffective. Consequently reliance has been placed on fumigation with methyl bromide. Research by the Stored Products Insects Section of the Agricultural Marketing Service showed that in the laboratory 2 pounds of methyl bromide per 1,000 cubic feet, applied for 4 hours at 80° F., killed exposed khapra beetle larvae in a gas-tight chamber. Subsequently practical tests by California workers and others were conducted with this fumigant under different warehouse conditions. Some warehouses contained from 1 to 3 million cubic feet of space and were expensive to cover with the plasticized nylon required. To assure that the proper concentration of fumigant was present for the required time throughout the structure and its contents, readings were made with a thermal-conductivity direct analysis unit at regular intervals throughout the period of exposure.

Flies and Mosquitoes.--In the event of an atomic-weapons attack or other national disaster, it is reasonable to assume at least temporary lack of adequate sanitation due to broken sewer mains, nonoperating toilets, and accumulation of garbage and animal bodies. Large populations of blow flies and house flies would occur in a matter of days, with consequent hazards in the transmission of various diseases, primarily gastro-intestinal, in surviving humans, and also to the health and comfort of livestock. Fly control under such conditions could be accomplished by the use of poisoned baits developed by Federal researchers. Bait sprays containing molasses, malt, or sugar and one of the organic phosphorus insecticides, such as malathion, Dipterex, or Diazinon, would give quick reduction of flies under nearly all conditions. Dry sugar baits could also be used. These materials could be distributed by airplane over an entire city or devastated area. These baits also kill roaches, less important disease transmitters.

Where destruction of hydrographic features result in water impoundment or flood conditions, mosquito breeding may increase with consequent disease hazards. Methods for controlling mosquitoes with insecticides under various situations have been developed and include ground and airplane dispersions of larvicides and adulticides.

Biological Control.--The importance of biological control agents in reducing the populations of destructive insects cannot be overemphasized. For some pests these agents afford cheap and sustained effective control without such hindrances as insecticide residues, difficulty in treating inaccessible areas and the need for yearly treatments. Stress on biological control during normal times would provide a backlog of beneficial agents to counteract possible emergency times when chemicals and machinery for distributing them might not be readily available. Let me cite two examples to show how beneficial insects have aided control programs.

The citrus black fly was first reported in Mexico in 1935 and gradually spread so that it is now found in most of the citrus growing areas. The Department soon became interested in the control of this insect as it spread towards the border and threatened the citrus industry in the United States and in 1943 introduced a parasite from Cuba to combat it. Although this parasite, of Malayan origin, controlled the black fly in Cuba, it was ineffective in Mexico because of the long dry period common to most of the citrus growing area. In 1950 the Department introduced a number of black fly parasites and predators into Mexico from the dry areas of India and four species became established. These rapidly increased in numbers and soon controlled the black fly at the points of release. From these initial colonization points large numbers of parasites were collected and released in all infested areas of Mexico. Control of the citrus black fly has been obtained in practically all areas of infestation in Mexico.

The Klamath weed, sometimes called St. Johnswort, Tipton weed, and goatweed, is of foreign origin. This weed was first reported in northern California about 1900. It spread rapidly, and by 1940 about 3 million acres of good rangeland in California and other States of the Northwest were infested. It can be controlled with 2,4-D and other chemicals, but this method of control is expensive and not suitable on range lands. From 1944 to 1950 the State of California, in cooperation with the Department, introduced five species of phytophagous insect enemies of the weed from Australia and Europe. These insects were carefully tested on various plants of economic importance to determine their suitability for release. Since their establishment over half a million acres of infested rangeland in California have been cleared by them and the native forage grasses thus allowed to return. More recently, these insects also have been released in Oregon, Washington, Montana, Idaho, and Colorado with varying degrees of success. (See figure 8, page 74.)

Explorations in foreign countries are needed to find insect enemies and diseases of other noxious weeds such as halogeton, Italian thistle, Mediterranean sage, Dalmatian toad flax, Scotch broom, and tansy ragwort that occupy vast acreages of rangeland in the West. Studies are under way to find biological control agents that attack halogeton.

Commodity Treatments.--In order to ship host crops or products in interstate commerce, and to meet both import and export regulations, the following types of treatments to kill insects or prevent their emergence have been tested by research workers: heat, mechanization, insecticides, cold storage, frozen pack, vapor heat, and fumigation.

Fig. 8. Field showing Klamath weed in foreground. The background shows the weed completely destroyed by C. gemellata feeding the previous year. Picture taken in 1953.

Heat Sterilization and Mechanization.--Heat sterilization of potting soil to kill Japanese beetle grubs and other pests has been an acceptable procedure for many years. Heat sterilization of cottonseed has been required to prevent the spread of the pink bollworm beyond known areas of infestation. However, recent research has shown that gins kill from 90 to 100 percent of pink bollworms, and the requirements for heat sterilization have been rescinded at gins where the seed does not move out of the regulated area. The value of this research to the ginning and oil-milling industries and to the farmers is conservatively estimated at $1.5 million a year.

Cold Storage.--This important treatment is approved for use in the United States on imported fruits and vegetables in connection with fruit fly quarantines. The fruit is precooled to its center to the desired temperature, near 34°F. held at or below that temperature for 12 to 20 days, depending on the species of fruit fly and the treatment temperature. Because imported fruit must be kept under refrigeration to prevent spoilage, cold storage as a quarantine treatment during the voyage has proved to be very practical.

Frozen Pack.--The frozen-pack treatment of fruits and vegetables consists of initial freezing at subzero temperatures and subsequent storage at not higher than 0°F. The method is used only against those insects killed by freezing. Commodities so treated must be used very soon after the temperatures are relaxed.

Vapor Heat.--In the vapor-heat treatment the commodity is heated to 110°F. by saturated water vapor, which condenses on the fruit or vegetables and gives up its latent heat. This latent heat raises the pulp temperatures quickly and evenly so as to prevent damage to the commodity. The 110° F. temperature is maintained for 6 to 8 hours in order to kill various fruit flies. Much research has gone into determination of which fruits and vegetables are tolerant to the vapor-heat treatment.

Insecticides.--Reference has already been made to the use of different insecticides as soil treatments to kill the Japanese beetle, white-fringed beetle, and other pests in order to permit shipment of plants outside of the infested areas without hazard.

Research also resulted in the use of DDT dust for treating sweetpotatoes in storage to prevent dissemination of the sweetpotato weevil. Work conducted during recent years led to the recommendations of dieldrin dust in 1955 and of heptachlor dust in 1956 for use on sweetpotato plants both in the field and in the plant bed to control the weevil.

Chemists and entomologists at Moorestown, New Jersey, have developed water-miscible ethylene dibromide formulations that can be injected into the soil around balled nursery plants to destroy Japanese beetles. The adoption of these formulations by Japanese beetle quarantine officials has greatly facilitated the treatment and shipping of such nursery stock from quarantined areas.

To cope with the problem of preventing the introduction or spread of agricultural and disease-carrying insects by aircraft coming from infested areas, special liquified-gas aerosols have been developed as space treatments. Carbon dioxide-propelled, pressurized sprays also have been designed to apply residual-type insecticides to interior surfaces of airplanes. The combination of aerosol and residual treatments has proved highly effective for the destruction of agricultural pests, which are in general less easily killed than the insects of public health interest.

Fumigants.--Hydrocyanic acid, methyl bromide, and ethylene dibromide are the fumigants most commonly depended upon for commodity treatments and their use on schedules developed by research permits the shipments of many crops that could not otherwise be moved from quarantined areas.

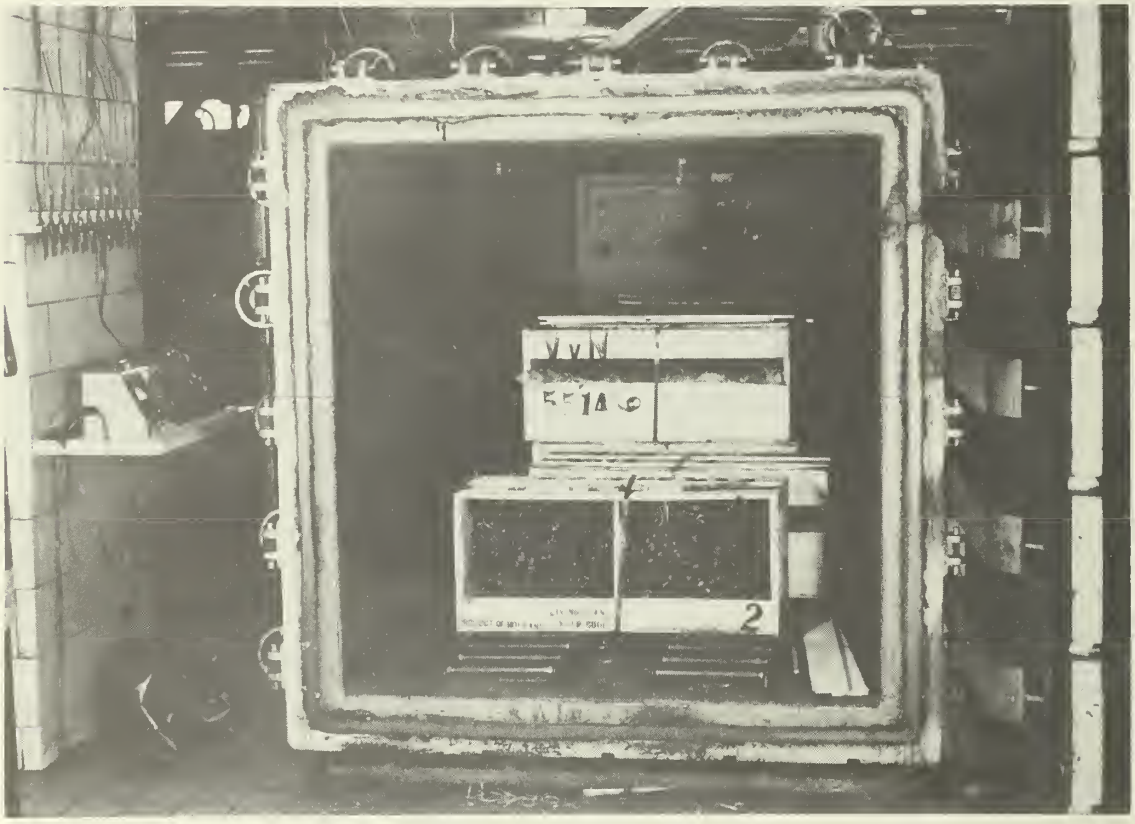

Fig. 9. 400 cu. ft. vacuum fumigation chamber, Inspection House, Hoboken, N. J. Cases contain Holland-grown azalea plants to be treated with methyl bromide. Chamber also used for experiment fumigations. Left foreground: Thermal Conductivity Unit used for gas analyses.

Methyl bromide gas is applied inside a tight metal-lined fumigation chamber provided with forced circulation of the air-fumigant mixture. It was first approved in 1940 for treatment of Hawaiian fruits and vegetables for control of the Mediterranean and melon fruit flies. A dosage of 2 pounds per 1000 cubic feet was specified, with a $3\frac{1}{2}$-hour exposure at 80°F. or above at normal atmospheric pressure. This fumigant has been of great use against many pests in different hosts, but unsatisfactory for others because of lack of host tolerance where heavy treatments are required.

Recent studies indicated that high concentrations and good distribution of methyl bromide could be obtained in fumigations of imported commodities under plastic tarpaulins and at cold temperatures near 40°F. The insecticidal efficiency was good, and the Plant Quarantine Division has made considerable practical use of this treatment, especially for emergency situations. Trials have also been run in vans loaded with Long Island potatoes lightly infested with the European Corn Borer destined for Cuba. Laboratory studies showed that the low-temperature fumigation was completely effective against the corn borer larvae, though some larvae remained alive but affected up to 3 weeks after fumigation.

Ethylene dibromide was found by researchers to be practically a specific treatment for fruit fly control and has been used extensively for treating fruits and vegetables in areas quarantined because of the oriental, Mediterranean, melon, and Mexican flies. A dosage of 1/2 pound per 1000 cubic feet is specified, with a 2-hour exposure at 70°F. or above under normal atmospheric pressure. Because of the availability of this treatment, fruit and vegetable shipments from Hawaii soared from a few thousand pounds in 1948 to about 3 million in 1952.

At the request of the Plant Quarantine Division, intermittent studies on cool-temperature fumigation with ethylene dibromide for treatment of imported commodities have been made over the last three years. The results indicate ethylene dibromide can be used effectively at temperatures near 55°F. to treat imported mangoes in connection with the West Indian fruit fly quarantine. Previous work had shown that this material would give complete kill in warm temperature fumigation. However, imported mangoes generally arrive in a precooled condition, and it had been necessary to warm them for 24 hours or more before starting fumigation. The new cool-temperature fumigation makes it possible to make treatment immediately after arrival, which not only saves much inspection time and trouble but is desirable from the quarantine standpoint. Cool-temperature fumigation with ethylene dibromide appears to have possibilities for wide practical use in quarantine control.

Need for additional research and adequate budgeting.--The foregoing report has pointed out many ways in which research has been of inestimable assistance to control and regulatory agencies in meeting some of their problems. Naturally positive results have been stressed more than failures, but it should not be concluded that research has solved all control problems, which are important, diverse in character, and frequently national in scope.

No matter what treatments are available, there is an ever-present demand and need for research to find cheaper, safer, and more easily applied treatments. Research must also be maintained to meet ever-changing needs. New concepts and new materials are continually offering new opportunities for better control methods.

When an emergency control problem arises, it is necessary for all interested parties, including representatives of research, control, and regulatory agencies, to consider the problem in the light of available information and to determine whether or not the future program should be geared to control or to eradication. Certainly before eradication is considered there should be a sufficient backlog in research to guide the initial stages of the projected program.

Effectiveness in operation by research and action agencies can best be arranged if the research needs are considered at the time control budget estimates are made. The needs of control organizations are of great importance on emergency insect problems, usually the only type they are called on to meet; consequently research to meet such needs is equally urgent. Therefore, it seems that a contingency research fund should be authorized and established to meet these specific needs as they arise. Currently, at least in the Entomology Research Division, to provide research information to service an action program, it is necessary to shift emphasis from other important work. Often this cannot be done to the extent required to carry out an effective research program. The regular budgetary process is too slow to meet emergency demands. A properly balanced budget between research and action programs in terms of both amount and timing of funds is essential for efficient operation and for good, coordinated working relationships.

RESEARCH SUPPORT FOR CONTROL AND REGULATORY PROGRAMS

Clay Lyle, Dean and Director
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Mississippi State College

It is evident that prior research if possible, or at least concurrent investigations, are absolutely necessary for successful operation of any control or regulatory program. It is useless to speculate on what might have been, but as chemists and entomologists struggle today to find effective poisons faster than the boll weevil develops resistance to them, I cannot help wondering if there had been some prior research on control measures, or even the strict enforcement of appropriate quarantine measures when the weevil started across the Rio Grande in 1892, we might be producing cotton at much less cost today.

There are many examples which prove the value of prior research in control and regulatory programs. The Mediterranean fruit fly is an illustration. I am certain that the present campaign in Florida is based on much sounder and more effective eradication measures than those employed when that pest was first found in Florida in 1929. In terms of the same kind of dollars, it is probably costing much less to eradicate the fly today than the first time, because of the research that had been conducted before this second outbreak. The approach this time is quite different from that in 1929.

To conduct research prior to the entry of any foreign pest, it is, of course, necessary in most cases to carry it on in the foreign country where the pest occurs. This means cooperation with other nations - hence good international relations are essential. Here in the South we are greatly interested in exporting our cotton, so we know that trade with other nations is necessary for our welfare.

To promote trade the plant quarantine officials of this country need to know much about the agricultural products of other countries, the way they are produced, the pests that attack them, and the danger of introducing such pests with these plants or products. About two years ago, the U. S. Department of Agriculture was severely criticized by a Congressman for conducting studies or paying for printing publications on the "Flora of Dominica" and "The Orchids of Guatemala". Actually, we need to know a lot about the flora of Dominica and a great many other countries, as well as the insects and diseases which attack them and the probable preferences of these pests for plants in the United States. Also, we need to know the natural enemies that hold them in check in their native environment. I regret that we had not discussed these matters with this Congressman, but we had no advance notice of his critical attitude on this subject.

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We need full information on the plant and animal life of other countries for defense in biological warfare. We must not forget that we are engaged in a life-or-death struggle with an enemy that will try to weaken us in every way possible. We must be prepared to fight against pests which may be introduced purposely into this country to hamstring our food and fiber production. The surveys made around the seaports of this country during recent years were apparently well justified.

Sometimes research developments with new chemicals may make control or eradication programs practical for a pest which had hitherto been regarded as impossible to eradicate. Also, a pest, previously considered of minor importance, may spread to a new environment where it attacks hosts of more economic importance, thus justifying greater expenditures for control or eradication. Again, there may be pests for which satisfactory controls have been developed and which have been considered too difficult and expensive to eradicate, but which may be delayed in spreading to new areas by suppressing the population in the most heavily infested sections and peripheral areas. In all these situations the importance of adequate research as a means of determining the nature of the program to be used is obvious.

The financing of research on imported pests is still a problem confronting both State and Federal administrators. Certainly, the research conducted in other countries should be by the U. S. Department of Agriculture. Also, it seems generally logical that the control and eradication of imported pests should be supported largely with Federal funds. No clear-cut policy has been followed. For example, State funds have been used in Mississippi for research on the imported fire ant, but not on the white-fringed beetle. In general, there is reluctance on the part of state legislatures to appropriate funds for research on a pest which is not yet in the state, but there are exceptions to this also. Several southern states which do not yet have the pink bollworm, including Mississippi, have made substantial appropriations to be used in Texas on this pest. However, this was done with a rather definite understanding that these funds were provided temporarily to support an expanded research program until more Federal funds could be made available. I am not certain that the Agricultural Research Service accepts this viewpoint, but the states are in general agreement.

HOW NEW AGRICULTURAL CHEMICALS ARE DEVELOPED

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When first asked to talk to this meeting, I was reluctant because I had so little contact with State and Federal regulatory agencies. I didn't feel I knew your problems, and consequently I was afraid I could not offer much of use or interest to you. However, the suggestion was made that I tell you just what it takes in the way of research to develop a chemical for a specific purpose. This, I thought I could do. Now, after spending some hours thinking and writing notes on the subject, I am not so sure. Several things stand out as general characteristics of this sort of business. First, and this is embarrassing to us, is the fact that I, at least, am not sure I know just how to go about discovering a chemical for a specific purpose. I have visited a number of industrial research laboratories and I have the feeling that probably our competitors don't have all the answers either.

Since we built the Shell laboratory in Modesto in 1945, we have gone through quite a few thousand new organic chemicals in a search for better materials to control insects, kill weeds, or to fumigate the soil. If we look back over our modest successes and particularly at our near misses, we find that the best herbicide we ever found was made as a lube oil additive - a chemical that originally synthesized for use against virus diseases has no toxicity to viruses nor to most fungi, but turns out to be uniquely specific and effective as a systemic fungicide against wheat rust. A near miss in the fungicide field was originally developed from a series of compounds made as detergents. And, of course, there are hundreds upon hundreds of compounds which on paper were perfect chemicals with all the toxiphoric groups, just the right degree of polarity, that were active sulfhydryl reagents, that fitted all the proper lock and key theories as antimetabolites, but that turned out to be absolutely no good for anything.

While we are quick to admit we have a lot of misses, we also hasten to point out that close cooperative planning between biologists and chemists is raising our batting average. Particularly in fields where we have gained experience such as Diels-Alder condensation products and in phosphate chemistry, our biological successes are increasing rapidly. When we get a new batch of phosphorus compounds nearly all of them are superior to commercial products in safety, residual or over-all toxicity, systemic action, or some combination of such useful properties. Our standards rise, and we are now discarding compounds that would have been eagerly developed ten years ago.

One point should be made clear at this time and that is the very large part played by industrial research laboratories in the discovery and

development of new materials. If we take the chemicals listed in Hubert Martin's Guide to the Chemicals Used in Crop Protection, we find that of the 43 chemicals which emerged prior to 1930, only 6 were developed as a result of industrial research, against 37 which came from tax-supported research institutions. These 6 were mostly the result of research in the German chemical industry by Bayer and I. G. Farben. This, of course, was before the time that United States chemical firms had initiated programs of this sort of research. Of the 161 listed chemicals which were developed after 1930, 12 have come from tax-supported research institutions, and 149 from industrial research. So by whatever reasoning or unreasoning process we use, we do frequently produce new and better chemicals in great number and variety.

Let me now run through the steps we take in our own agricultural research division in the development of a chemical. Perhaps you can judge from this account how complicated our business is, how well we are doing it, and why there are not more industrial organizations with integrated programs of agricultural chemical research and development.

Since most of our compounds are synthesized especially for possible agricultural application, the first step in our program is discussions between the biologists and chemists. We need and have several men on our organic synthesis staff who are experts in agricultural applications and biochemical theory, so many of our best ideas come not from the biologists but from the chemists. Biologists have a tendency to ask impossible things of the synthesis people, but sometimes the chemists can do them. We find that we need about as many chemists synthesizing compounds as biologists screening them for agricultural application. Our group of chemists turns out several hundred compounds a year each designed for a specific purpose. We add to this number by purchased products and by occasional compounds from other lines of chemical research in the company, particularly if these compounds offer new and interesting structures. An important point is that we are not limited in our work to raw materials from the petroleum industry.

Biologists receive these compounds in lots of 10 to 50 at a time, generally in 5 to 10 gram quantities in sealed vials. With these 5 to 10 grams, which may have taken several months and several hundred dollars to prepare, the biologist must make all his screening tests. We have concentrated on pests of plants in our program. Almost all compounds are screened against seven or more insects, for five or six particular uses as herbicides, in three or four different ways as nematocides, and against six or more plant diseases. In addition, we generally look at the compounds for their growth-regulating properties or occasionally for such special uses as algicides, fabric preservatives, or bacteriocides. Compounds are not regularly screened for pharmacological use or as veterinary medicines. The screening program is designed to evaluate the good compounds as well as to pick out the useless ones. A compound is seldom put into dead storage unless it has been screened for at least 20 different uses and found completely inactive in all of them.

When a compound shows any appreciable activity, it is given repeated screening tests which are followed by greenhouse pot tests, soil mix tests, or against larger insect populations. Still with the original 10-gram quantity, we are generally able to determine the degree and range of biological activity of a new compound. This is only the beginning but it generally exhausts the original supply of sample that we have on hand.

Our next step is to ask the chemists to prepare us one to five pounds of the material for extended testing. Because the preparation of this amount requires considerable time, special apparatus, and quantities of costly purchased intermediates, the chemists generally take a good look here at the potential cost of manufacture, insofar as they can judge this from the cost of raw materials and the complexity of the process of synthesis. At this time, samples are sent to Stanford Research Institute for first evaluations of toxicity to vertebrates, the Patent Department is alerted and we begin to think about the size of potential markets, particularly if the uses seem to be unique or new to agriculture.

This one to five pound batch generally lasts a year. During that time, we make field tests on a variety of crops, but generally only on our own farm or neighboring areas near Modesto. At the end of this year, we should be in a position to prepare some preliminary estimates of cost and profitability, we should know considerably more about acute oral and skin toxicology, we will have determined most of the chemical and physical constants that are necessary for proper formulation and handling of the compound, and we should know a lot about the potential phytotoxicity of the compound if it is to be used on living plants.

This is about as far as we can go completely independent of cooperation from State and Federal agencies. We are most anxious not to ask these tax-supported research institutions to do our preliminary screening for us. At the same time, we have found that most experiment stations and field workers in the Agricultural Research Service, in large grower associations, and in branch experiment stations are anxious to have new compounds that show some promise for the specific programs they have in hand.

At this point it is well to recognize the difference in our fundamental approach to the development of new agricultural chemicals, from the approach taken by tax-supported research workers in field stations. We start out with an idea - maybe a chemical idea, maybe a biological idea. We know several places in agriculture where we would like to see this idea applied. We would like to see it fill as large a need as possible. Frankly, our aim is to develop something that can be sold either for high prices or in multi-million pound quantities. We do not work on insecticides, on cotton defoliants, on fungicides, or nematocides - we work on ideas. The State or Federal worker also works on ideas, but he has a special problem to solve. He has to get rid of an outbreak of the burrowing nematode, the Mexican bean beetle, or of Klamath weed. His

approach is a logical one - namely to get all the chemicals he can lay his hands on which may have some possible application to his particular problem. These chemicals will then be tested in competition with each other and the best selected for the purpose in hand.

We now enter a period of active cooperation with State and Federal experiment stations and field stations. We have a particular group in our organization called the Product Application Group, under the direction of Dr. E. F. Feichtmeir, whose job it is to know of all of these problems throughout the United States and to take our chemicals in hand and visit the various workers who deal with these problems. Where, and only where, there is a mutual interest in attacking a problem both from the chemical standpoint of industry and from the control standpoint of the experiment station worker, do we get together on a cooperative venture. The nature of this cooperative venture depends on the circumstances. If the worker is short of funds but interested, we may make a small grant-in-aid. If the worker needs 25 or 50 pounds of chemical for a large-scale application, we try to furnish the chemical. If special application equipment is needed, we will show him how to build the equipment, or sometimes loan the equipment to him. We try to be helpful in the solution of his problem. It is not always possible for us to be present when the applications are made or to check back frequently for subsequent applications, phytotoxicity readings, or counts of the population. To this extent we depend upon the field man who is on the job. When the data are ready to be taken in final form we make every effort to be present, even though this is not always possible. The data are generally written up by the field man for publication or in his annual report. Out of courtesy to us, we are generally sent copies of the data as soon as they are obtained and these are collated by us to serve as a basis for our frequent discussions about commercial development of the compound.

At the time we are ready to take a compound into the field and offer it for cooperative testing, we are generally in a position to disclose the nature of the compound and give full data on its chemical and physical properties. In a few instances, this is not possible. Because of the urgency of the problem in hand and the possibility of saving a season's work, a chemical may be supplied in limited quantity under code number before our patent position is finalized. If this is necessary, confidential disclosure of the nature of the compound is generally made to the department chief in Washington or to the head office of the experiment station. Such testing of materials under code is not expected to be extended beyond one growing season.

This period of field testing under the Product Application Group may extend from two to four years. During this time there is a very large amount of information that needs to be obtained. Some of these things are: (1) determine dosage requirements for major uses; (2) develop information on phytotoxicity, mode of action, persistence, and on other

field performance characteristics; (3) develop additional information in the laboratory by use of radio chemistry or other special tools; (4) evaluate compatibility with other pesticides, stability, significant impurities, etc.; (5) develop formulations aimed at commercial usage on a practical scale; (6) initiate preliminary corrosion studies; (7) complete patent application on a world-wide basis; (8) develop preliminary analytical methods; (9) initiate residue data; (10) initiate preliminary flavor or quality studies; (11) initiate manufacturing process studies; (12) develop any special application equipment or techniques required; (13) develop market potentials and profitability. After these things have been done in the initial stages, many of them need to be repeated another year and sometimes even more. To obtain sufficient residue data for experimental labels on limited major uses is always at least a two-year project. Extended feeding tests which are necessary under Food and Drug Administration regulations also require at least two years of sponsored research at some institute or college of veterinary medicine.

The biggest single job from the standpoint of cost and time is the collection of residue samples from the different crops on which the chemical is used. Applications are frequently made only to obtain these residue samples. This problem is simpler with volatile fumigants which disappear from the soil before the crop is planted or with herbicides which are not applied to food crops than it is with insecticides for use on vegetables and fruits. Nevertheless, the problem differs only in degree and not in kind.

The question naturally arises as to when in this development program we in industry can be of assistance to you whose responsibility it is to suppress or eradicate a new pest. The answer would seem to be that new compounds are not likely to get into control or eradication programs until they are fairly well along in their process of development. The reason for this is that we simply do not know how effective the compounds are until we have worked with them for several years. Since you will generally be dealing with a problem involving an insect or other pest new to us, and one which we cannot transport to Modesto for trial, it would be up to you to determine for yourselves how effective the new compound we might have is in your particular problem. We may have ideas for trial if the problem is new and unique - a problem for which no effective material is commercially available at the present time. For instance, several years ago, the California State Department of Agriculture wished to remove the crop of cherries completely from a small number of trees in the northern counties of the state where cherry fruit fly had made an occasional appearance. We were able to supply a small quantity of a new maleimide which was 100% effective in killing cherry flowers. To our very real regret, and I assume to the State's regret also, we were unable to supply the several hundred pounds required for spraying all of the cherry trees in the area. If this compound had been a little simpler to make and if we could have seen any other commercial offtake for the product, you may be sure that the State of California would have had the first 500 pounds of chemical that came from our pilot plant for their eradication program.

When D-D was first found effective against the golden nematode on Long Island, we had already contracted most of our visible supply to the pineapple growers of Hawaii. Just after the war, manufacturing facilities were limited and there was a very real problem to find enough D-D to treat the number of infested acres on Long Island that needed to be treated with the heavy doses of D-D recommended by the research group. We did find the necessary chemical, and in future cases we will also try very hard to supply such chemicals as are needed when it is within our power to do so.

If I may return for a moment now to the question of how new chemicals are developed, I would like to make a few guesses as to the future. In the first place, the advances we have made in understanding are still not enough. The Edisonian approach of screening miscellaneous compounds by the thousands has produced some outstanding materials, but we feel an ever increasing need for chemical and biological coordination. This need is a principal reason why Shell is now spending over a million dollars to bring our chemists and biologists together at Modesto.

Not all of our good chemicals were discovered by accident. An outstanding example is the growth regulators leading up to 2,4-D. The existence of a plant hormone or auxin was verified at the University of Utrecht over 25 years ago. The discovery of a naturally occurring material in plants which acted something like a hormone resulted first in the laborious separation of the compound from the plant, the establishment of chemical structure, and finally, synthesis of a number of compounds of similar structure which had growth regulatory effects. The antibiotics were also developed logically through a series of steps founded on basic research. The newest sensation in the growth regulator field, namely, the gibberellins, have a somewhat similar history arising from the observation in Japan that diseased rice plants exhibited odd growth characteristics. As with the auxins and with the antibiotics, workers laboriously extracted and concentrated the effective ingredient, established its structure and developed new applications for the material.

The synthesis of most antibiotics and of gibberellic acid has still to be accomplished. It took us nearly 25 years to do this with the pyrethrins and it may be even longer before we accomplish it with some of the new growth regulators. But this is a new and important avenue to better and more effective agricultural chemicals. This, then, is one way in which we may find new chemicals in the future.

The second way in which new chemicals are going to have to be developed is through more basic research in insect physiology and biochemistry. The house fly problem was solved and unsolved in the short span of five years. We are beginning to unsolve some of our miracle cures for mites, codling moth, boll weevil, and other major pests. The time is short for us to learn how insects develop resistance to the new synthetic organics. We in industry are probably not going to solve this problem. Even with possible agricultural applications beginning to come from the pharmaceutical firms, our efforts in industry are still negligible compared with those

of the great medical research institutes and in our leading endowed universities. Although the United States Department of Agriculture and the State agriculture experiment stations are also doing a great deal of research along fundamental lines, they are under pressure for practical results. It is for these reasons that I think industry, the experiment stations, and the United States Department of Agriculture must watch very closely the fundamental research that goes on at the Sloan-Kettering Institute, California Institute of Technology, and Harvard University. Those fellows are not often concerned about the practical applications of their discoveries. It is up to us to catch the practicability of some of their thoughts. You can be sure that we in industry are watching this work very closely. Many of the new discoveries are going to be applied to problems which are not even recognized as problems now. By this I mean that new agricultural chemicals will be even more significant to the control of crop growth and maturity than to the eradication of pests.

In conclusion, I would like to make the guess that cheaper and more effective agricultural chemicals are certainly forthcoming from research in industry, but that they may not be good enough to change the approach which you gentlemen must make to your own specific problems. Since the first agricultural chemical was developed, the experts and advisors have been saying that chemicals were no substitute for good husbandry, that basic toxicity of an insecticide could not be a substitute for thorough spraying and timely application. This is true today, and will be true 50 years from now. I think the situation as summed up by Matthew Cooke who was chief executive horticultural and health officer for the State of California in 1881 is just as appropriate today as it was 75 years ago when Matthew Cooke included it in his book, "Injurious Insects".

> "Our watchword must ever be, 'Onward and upward, and falter not, although difficulties apparently insurmountable arise: he who will may overcome them.' The enterprising fruitgrowers of California are filled with a spirit that no power on earth can curb. It falters not at misfortune's door or any obstacle to success, but boldly advances and removes them all; at least, it has been so, and must ever be. The time was when our glorious climate, fruitful soil, and exemption from all diseases and pests, made our Golden State the wonder of all who were conversant with its fruit and flowers. Now, alas, the spoiler's hand is felt; a change has come over the spirit of our dream. It seems as though all that is detrimental to the fruit interest is here or coming, making eternal vigilance the price of success in this, the industry of the State. The time has come when everyone who by this occupation would thrive will find ceaseless use for head and hand; even then the fittest only can survive. Who will supinely sit and see misfortune spoil the results of years of toil, while others gird on their armour with energies stimulated by the presence of the forces arrayed against them on every hand?"

CAREERS IN ENTOMOLOGY

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It is paradoxical that proportionately few young men are preparing for careers in entomology at a time when employment opportunities for qualified entomologists have probably never been greater. In the spring of 1957, for example, only ten students of entomology were listed among the graduating seniors ranking in the upper third of their classes in the colleges of agriculture of twenty of our land grant institutions. The present shortage of properly trained entomologists, particularly in publicly supported agencies, has already created serious problems which must be remedied as soon as possible. This discussion, originally conceived under the title "Training for Careers in Applied Entomology", has been modified to include comments on the causes of the present shortage of qualified entomologists, possible sources of future entomologists, the training of entomologists, and the important problem of "keeping" entomologists, particularly in public service.

The Present Shortage of Entomologists

The present shortage of qualified young entomologists is probably associated with the following factors:

The profession of entomology has become more complicated with increased knowledge, new problems, and the more intricate nature of many of its present activities. Former methods of recruiting and training entomologists are no longer fully adequate for present needs.

Our rural population, which has supplied a large proportion of our entomologists and other agricultural scientists, has steadily declined. Fewer young persons have had opportunities for direct contacts with the problems and satisfactions of scientific work in fields related to agriculture. This is reflected in the reduced or relatively static enrollments in the colleges of agriculture of most land grant institutions.

The present crop of college students was depression-born and is probably smaller, in proportion to the total population, than at any time since 1944. In the resulting competition for new manpower entomology, and the biological sciences in general, have fared less well than other pursuits.

Starting salaries for entomologists, particularly in public service, have been too low, in the face of competition from other professions and pursuits, to attract enough young men of the caliber needed.

Older entomologists, particularly in government service, are retiring faster than qualified young men can be found to replace them and to do the additional professional work required by a growing population.

If future needs are to be met, greater efforts must be expended in locating, recruiting and training young men interested in becoming entomologists and in keeping them in the profession, particularly in governmental service, after their training has been completed.

Sources of Future Entomologists

An abundant source of future entomologists is available in the students now enrolled in the elementary schools and the high schools of the nation. An increased birth rate, which began with World War II and has since continued, will result in a larger supply of manpower, including entomologists, within the next decade. It is desirable at this time to search for promising young people who might, with encouragement and guidance, develop into superior entomologists within the next few years.

A recently reported study of the early backgrounds and activities of over 60 outstanding scientists revealed, with some exceptions, a common and somewhat unexpected pattern of traits. Between the ages of 12 and 18 the average outstanding scientists could have been recognizable as:

The son of a farmer or a professional man.
Frequently of a sickly nature.
Shy and retiring rather than gregarious.
Not particularly interested in the opposite sex.
Frequently with but one parent living.
Not a particularly good student, but strong-willed and determined in matters where interest was keen.

It was also revealed that the average outstanding scientist did not choose his life work until the third or fourth year of college, usually after the impact of an inspiring contact with an outstanding teacher. This study suggests clues for the detection and encouragement of present-day teenagers with potential interests in the study of entomology.

It is the responsibility of entomologists to attract young people toward the profession by such activities as the following:

Personal example. The example of a diligent, enthusiastic and effective entomologist in action, who will take time to explain his work to his young visitors, is a particularly valuable advertisement for the profession.

Encouragement of the organized study of insects by such groups as 4-H Clubs, the Future Farmers of America and the various scouting organizations.

Extending invitations to selected groups of young people to visit entomological laboratories in action.

Demonstration of a personal concern for young men who have displayed a particular interest in the study of insects. Part-time or summer employment may often be made available.

Publication of leaflets and brochures, written to interest young people in the opportunities and professional requirements of careers in entomology.

Utilization of every proper opportunity, including newspapers, magazines, radio, television, exhibitions, and illustrated talks, to publicize the importance of entomology and its career opportunities.

Intensification of efforts to interest younger college students in the study of entomology. This includes the improvement of introductory courses, contacts with teachers of the highest caliber, more effective counseling and guidance of interested students, work opportunities and, by performance and example, maintaining a high reputation for the profession on every campus.

The Training of Entomologists

"...No man can be truly called an entomologist, sir; the subject is too vast for any single human intelligence to grasp." Oliver Wendell Holmes.

The reader is referred to an excellent paper by Dr. Stanley B. Freeborn, entitled "The Training of the Professional Entomologist" (Bulletin of the Entomological Society of America 2(4):23-24. 1956), which is particularly pertinent to the present discussion. The following comments may be considered as an amplification or re-emphasis of some of the points Dr. Freeborn has so ably presented.

In commenting on the recent growth of the science of entomology, Dr. Freeborn states that "I doubt very seriously if there is an entomologist alive today, no matter how renowned, who has at his command as large a percentage of the known knowledge of entomology as the average Bachelor of Science graduate of my vintage had forty plus years ago." With our expanded knowledge much of the older distinction between "pure entomology" and "applied entomology" has disappeared. The truth of L. O. Howard's statement, made many years ago, that "All entomology is applied entomology" has been demonstrated many times in recent years.

In the expansion and specialization of our science there has emerged a need for at least two types of entomologists, both equally essential. Both may properly be called professional entomologists by Freeborn's definition, ("One who can do creative occupational tasks without supervision."). One group may be designated as TECHNOLOGISTS, or applied scientists, and includes those entomologists who complete their academic training with a Bachelor's, or occasionally a Master's, degree. Such men receive their additional training and experience on the job and hold important and often well-rewarded positions in industrial and governmental service. Many more young men are needed for positions of this type. The second group of entomologists, for want of a better name, may be called the SCIENTISTS, and are usually more specifically designated according to their various specialties such as insect taxonomist, insect anatomist, insect physiologist, insect toxicologist, insect pathologist, etc. For such entomologists, the basic preparation represented by the Ph.D. degree is essential.

Technologists, as defined above, should be broadly grounded, with at least introductory courses in the physical, biological and agricultural sciences, with not over one-fifth to one-fourth of the undergraduate period devoted to entomology courses. I endorse Dr. Freeborn's prescription of the following undergraduate courses in entomology: general entomology, advanced taxonomy, combined insect anatomy and physiology, insect ecology, economic entomology and summer practice. Men planning to enter business or administrative phases of entomology should also take at least introductory courses in economics and business administration. The importance of a superior command of the English language and a background of cultural courses cannot be overemphasized. A man is more valuable as an entomologist if he is a well-rounded person and a good citizen.

The entomological Scientists, as defined above, must be increasingly well grounded in basic physical and biological sciences, mathematics, and languages, often at the expense of entomological courses during the undergraduate period. It is not always possible for a young man to have decided on entomology as a profession at the start of his undergraduate courses, although this is particularly helpful for the efficient scheduling of courses. Numerous successful entomologists have begun their training by specializing in other physical or biological sciences, often under a liberal arts program, and have become interested in entomology as graduate students.

The importance of proper attitudes in future entomologists cannot be overemphasized. One survey has suggested that but from one-fourth to one-third of the value of a man to his employer is represented by his professional knowledge and technical skill. The major portion of his value, by this standard, is represented by such factors as integrity, enthusiasm, diligence, and ability to work effectively with other people. Without these essential personal qualities professional training is of limited value.

In any effort to increase the quantity and quality of future entomologists the possibility of more effective programs of financial assistance during the training period should be considered. In the past, the Federal service has received a relatively smaller proportion of the better young entomologists because it has not supported them during their period of training and apprenticeship to the same extent as has been done by private industry and by most colleges and universities. The student trainee program, recently established by the United States Department of Agriculture, is a step in the right direction but should be expanded to encourage and support outstanding graduate students. With proper planning and publicity such a program could be developed as a means of recognizing particularly outstanding young men. The sense of scholarship, honor and prestige thus created should tend to attract outstanding students toward permanent employment in the Federal service.

Keeping Entomologists in Public Service

No discussion on careers in entomology, particularly in relation to the work of the United States Department of Agriculture, would be complete

without some mention of the serious problem of encouraging young men of high caliber to enter and remain in public service. Particularly associated with this problem are salary factors and morale factors.

Until more realistic salaries are available, it is likely that relatively few entomologists of high caliber can be induced to enter Federal service. Many essential governmental services can be adequately performed by entomologists trained as technologists, as described above. Such men, with Bachelor's degrees, should ordinarily be paid at least as well as men of comparable training serving as high school teachers of vocational agriculture or as assistant county agricultural agents, for example. The present GS-5 rating ($3670 per year) ordinarily offered young college graduates entering Federal service is much too low to attract and keep men of the type needed. To secure superior men, it is suggested that more preliminary training and indoctrination be conducted through the student trainee program and that higher starting salaries be paid men selected for regular employment. To meet the present competition for superior men, no entomologist worthy of the name, with a Bachelor's or Master's degree, should be employed on a permanent basis in the Federal service at a starting salary of less than $4800 to $5000 per year. On this basis, entomologists with Ph.D. degrees should not be employed at less than $6300 to $6500 per year. If these standards, with revisions to meet competition for manpower and changes in living costs, were adopted, it is probable that superior men could be obtained in sufficient numbers to fill existing vacancies and to meet future requirements. If these needed adjustments in salary scales were adopted, it would also be necessary to make corresponding changes in salaries of the better entomologists already employed and who should be encouraged to remain in Federal service.

All employers of entomologists in a free country must give continued attention to morale factors which can either contribute to loyal and effective performance or lead to discontent, resignations and unfilled positions. Without coddling or toleration of incompetence and inefficiency, every effort should be made to maintain and strengthen morale by enlightened administration, elimination of needless restrictions and restraints, encouragement of individual creativity, recognition of effective work, adequate salary and promotion standards, and particularly by the adequate support of an outstanding program of entomological work on a high professional level.

TRAINING FOR A CAREER IN APPLIED ENTOMOLOGY

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In view of my thinking on this particular subject matter I wish, at the outset, to clarify my assignment, "Training for a Career in Applied Entomology." The title does not cover the field of preparation for research as that term is usually accepted, although it does cover, to some extent, the need for research knowledge as it may apply to the functions of the applied entomologist (pure entomologist and economic entomologist). What I have to say could well cover, in a general way, regulatory work, extension work, and some phases of teaching. Applied entomology covers an extremely broad field of activity; however, I shall restrict my remarks as near as I can to subject matter in the field under consideration at this conference and closely related subjects and examples. I may wander from some of the definitely professional phases to the other extreme of applied phases.

I have attempted to avoid some of the usual routine analyses covered in papers of this kind for the purpose of including at least some ideas which I hope are more or less original in my field of endeavor. When one is concerned with plant pest law enforcement in this field, as well as teaching and training, the whole horizon is naturally broadened. Before preparing these notes I reviewed, to some extent, the history of papers treating the general subject of training and teaching for this purpose, and that. The various journals, professional, educational and otherwise, had a sprinkling of such papers, many of them very similar in approach and as a rule emphasizing the need for certain college courses; the academic training necessary; the personnel deemed necessary; public relations requirements, etc., and even how the worker should dress and present his material, etc.

In order that it may not be said that I have neglected some of the more fundamental requirements I would like to quote from a recent article written by Dr. Stanley B. Freeborn, Provost, University of California.

"The Training of a Professional Entomologist"

> "My prescription for undergraduate courses in entomology is very short. It consists of five courses: (1) general entomology; (2) advanced taxonomy; (3) combined insect anatomy and physiology; (4) insect ecology; and (5) summer practice.
>
> "The general entomology would include an introduction to all the specialized fields -- classification, structure, physiology, ecology, biological control, agricultural and medical

entomology and the beneficial effects of insects. The laboratory would be devoted to the recognition of the various families of insects. In my college this course would be frankly a proselyting device to introduce a relatively large number of students to the fascinations of the field in the hope that every year a few of the outstanding participants might be lured into the field of entomology.

"Taxonomy. The logical arrangement of the subject matter is the basic starting point of any human activity. This truism is particularly accurate in all branches of entomology. The world's worst entomological mistakes have originated almost exclusively in faulty taxonomy. The ground rules of zoological nomenclature and at least an avocation in the systematics of some group of insects should be included in the program of every entomologist.

"Anatomy and Physiology. External anatomy goes hand in hand with taxonomy and serves to explain the landmarks and the vagaries of configuration that fall into logical sequences once they are understood. Internal anatomy and physiology when taught together become a fascinating introduction to some of the most intriguing and ingenious devices of nature.

"Ecology. Here we can develop the combination of all our knowledge of taxonomy, anatomy and physiology into a dynamic picture of how a specific insect fits into a given environment. It is the very heart of man's understanding and control of insects.

"Summer Practice. This is a capstone course that should occur during the vacation following the junior year. It may be a prolonged collecting camp that specializes on taxonomic work; it may be survey work; it may be in connection with experiment station research, but it should bring the student face to face with living insects and the way they live and interact with other organisms. It is important that this work should be supervised by the keenest minds and the best and most enthusiastic teachers that the department possesses because it is at this point that entomologists are made.

"I would add only one entomological course to this list of five specifically for the undergraduate who is planning to enter business at the end of four years. That would be Economic Entomology as a springboard for his work in sales of agricultural products.

"This proposal that I have advanced amounts to less than 20 percent of the units generally required for a bachelor's

degree. The 80 percent that are left are barely enough to acquire the natural and biological sciences that are basic to progress in one's entomological thinking, to acquire knowledge of the world in which we live and above all the act of communicating with our fellow men.

"The entomological sections of most college catalogs are cluttered with what I call ad hoc courses. They are designed for intensive study of small fragments of entomological endeavor such as "Insects affecting seed crops", "Coccidology" or even "Culicidology". They are handy capsule-type offerings that gather the available literature together in easily digested form for the student to gulp down without the exercise of much more intelligence than that of a parrot. However, when the student is deluded into taking these courses he is restricting the offerings that he can obtain only in college.

"If an entomologist is worth his salt he is going to be an avid student of his field all the rest of his life. College is only an introduction. His undergraduate training should be a thorough indoctrination in the basic elements of his field where his appetite is whetted to keep him always abreast of his field of interest."

This well summarized statement by Dr. Freeborn shall then suffice for our recognition of the so-called basic requirements. I have found nothing in the literature available for the last thirty years where it is so well stated.

For those of us who have had thirty years, more or less, training in our fields of endeavor, it seems a simple matter to sit down and outline our thoughts as to training requirements but in practice it is not as easy as it sounds, especially when the trials and tribulations and experiences must be summarized in a twenty-five or thirty-minute presentation. In fact, I spend the first hour of my lecture course in "Legal, Regulatory Aspects of Pest Control and Pest Control Administration," informing the students of the approximate subject matter to be covered the other thirty odd hours of the course, and to be sure, no doubt something will be said or thought on the completion of this presentation as to why did he omit this or that important phase of training or teaching, and doesn't he think we realize the importance of some of these simple things he has mentioned?

Therefore, then, I wish to proceed to outline some of the bare requirements with such examples and illustrations as time allows to illustrate various points. I shall also attempt to cite some requirements and notes of interest which seem to be absent in the numerous papers given on training a person for these particular fields of interest, simple as they may seem to be. Limiting my assignment to applied entomology rather than to professional entomology helps some but where do we separate the

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two? I say they cannot be separated if we are to do justice to the whole field of endeavor. That is apparent after studying the numerous papers given on this subject over the years. I purposely want to make my whole approach just a little bit different because I believe some of the more important factors have not been adequately taught, if at all.

First, let's assume that "applied entomology," as we will treat it here, covers the general fields of regulatory, extension, and commercial or industrial application, including the sales field. These areas can be broken down into a great many sub-fields again such as horticultural inspector, plant quarantine inspector, foreign plant inspector, transit inspector, apiary inspector, forest pest control specialist, nursery inspector, port inspector, field crop specialist, or supervisor, or chief, or state entomologist, or director of one or more of these fields. Let it be understood that no matter which field we consider, education as we call it is the fundamental over-all requirement.

I find that too many students go too far into a particular field of entomology without knowing where they belong in respect to related fields or institutions. Almost every state and university places the various fields of applied entomology in a different relative place. Where should a particular regulatory job belong? What is the relationship of the regulatory work of a state or country to research, extension, teaching and industry? We have no given formula for the ideal organization, in democratic countries or otherwise. How hard and fast should we draw the line as to where one activity starts and leaves off? In some states the regulatory work and various other functions of applied entomology are assumed by the state university or a similar institution, in some the state departments of agriculture, and in others there are combinations of these where control is jointly the responsibility of the university and the state department of agriculture. What I am driving at here is that I believe the trainee should know where he is going to belong, whether he is to work in the state government, the United States government, or the government of a foreign country. He should know what his jobs and responsibilities are in relation to the other branches and departments of government. In other words, he should know his organizational position. If he does not, he will sooner or later be in trouble. More than once I have talked to graduate students who were just leaving for a new job or assignment with the United States government, when they expressed little if any idea of what they were getting into or where they were going. A student should know where his profession or specialization belongs, while he is being trained or taught. You might say the student should obtain this kind of information from other courses, but does he? Time does not allow me to indicate where I think all of these functions in applied entomology should be in relation to where they are or may be. I do attempt to point out where the fields of applied entomology and applied plant pathology belong using existing State, Federal and foreign examples of organizations. After dealing with these various organizations for thirty-six years, it has become rather clear to me as to where applied entomology units might

best belong in order to function to the greatest advantage of those in the field and for the taxpayers. I try to tell the future applied entomologist what he might strive for in the way of organization in the interests of his profession.

What does the average student know about the importance of his profession in his state or country or throughout the world? Can he sell it and how would he go about it? The entomologists' slogan in 1954, the 100th century of entomology in the United States, was "Fight Your Insect Enemies." Entomologists have estimated the annual loss at four billion dollars a year. How, where and when does this occur? Does he know that entomologists have, according to Dr. H. H. Ross, found ways of controlling most of the 6,500 or more different kinds of destructive insects in the United States? Does he know that thousands of insect species of economic importance are intercepted at our borders each year and has he any idea of what can be done to strengthen the so-called first line of defense or the second line of defense? Does he know, or does he even vaguely understand the full impact of a biological war? If he has the education and training necessary to cope with the problems we face from day to day and year to year he will be able to help his country a great deal more in the case of biological warfare. I have often thought it is unfortunate that we cannot, on occasion, transport our trainees immediately to a problem area somewhere in the country during his training period. Certainly there are examples available year in and year out somewhere in the United States. In other words, we have the best available laboratories possible, but we do not make use of them. It would cost too much. On the field examinations of a problem area would be of inestimable value to a trainee and as I have pointed out such problems are always available in some part of the country.

Too often we neglect the history of entomology and all of its implications. What has happened since Townsend Glover was employed as the first Federal entomologist in 1854? The development of applied entomology up to and since the advent of DDT we will find just as important as the tremendous advances we brag about since the advent of DDT, if we study them carefully. We do not have the opportunity here to give the foreboding list of foreign insect and plant disease enemies which have become established in this country during the last 100 years to stay. What is the history of every introduction of a pest which has become established in this country, even in an extremely small restricted area? What happened to each and every one of them? Why were so very few of them eradicated early after introduction? Why did so many of these pests go beyond the second line of defense? And why are so many of them continuing to advance across the country at the present time in spite of our great knowledge and equipment?

To those of us who have been in this work for a long time the reasons are obvious; but are these reasons studied in detail by the trainee and his teacher? What mistakes did the State and/or Federal government make

in dealing with these pests? In general, the answer is "too little too late" and here I speak of knowledge as well as action and material. Even though history clearly tells us in detail what happened to cause the numerous failures, and successes as well, we continue to make the same mistakes over and over again. What beautiful examples we have in the history of our pest outbreaks of native as well as exotic species, but do we use them?

What does the trainee know about the organization and administration of a pest control campaign? He may be the best man in his specialized field of taxonomy, ecology, biochemistry or any other majors or minors he is concerned with, but does he know how to do his job without making the mistakes many of us have made and which we did not, but should have, recorded for posterity? How many mistakes have we pest control people made time and again because we did not take the time to carefully record case histories of procedures and results? I can cite mistakes which have cost millions of dollars for control, as well as in crops lost. Let us follow through and have our students study some of the more important factors or procedures which we have learned about over the years; procedures which must be considered in proper sequence when dealing with any pest control emergency in general but in particular with "outbreaks" as we so often call them.

We could, for the sake of simplicity, divide the approach into two rather broad categories; the immediate control or eradication and the long term or biological approach. I shall briefly elucidate only on the first approach with many of its implications because this is the area of responsibility for which most of our academically trained men are so poorly equipped. Do they know what organization means? In general, we might say, "there must be an organization for the application of scientific and practical methods to be used, combined with the injection of business principles." If an entomologist or plant pathologist does not recognize or realize the full significance of this simple statement, he is doomed to failure, and probably disaster, before he is even well under way with a control or eradication campaign. Whenever possible, an existing organization or agency of the local, the State or the Federal government must assume the initial responsibility. Who is going to start the ball rolling by first positively identifying the insect, pathogen, or whatever the organism may be? I stress the existing organization because we have learned that there must be a continuing organization of responsibility, a minimum unit of trained workers ready to move against any plant enemy. We must be so organized that "minute men" are available for these emergencies, as well as in any army of defense. Plans should always be included for immediate utilization of all available expansion of scientists, technical workers, specialists, labor, material and equipment on very short notice. I wish to state here that it has been only through failures in organization, or lack of organization, that some of us have been able to establish a basic permanent nucleus for our immediate or emergency action. Sometimes we have had to wait for one or more outbreaks in order to, first, even establish a control organization and, second, to expand

an organization and, of course, many of us are well acquainted with the difficulty of reducing the expansion when the emergency is over. In a campaign, then, we must consider at least the following factors and procedures, assuming that we have something with which to start.

I have mentioned positive identification of the species. Positive identification may justify considerable anxiety and action, or it may reduce concern. As Stanley B. Freeborn of the University of California says, "The world's worst entomological mistakes have originated almost exclusively in faulty taxonomy." How many of us can cite the concern and actual control of an insect or plant pathogen that "just wasn't."

And incidentally, do some of us know of a case or two where the discovery of a serious pest, new to this country or new to the area, was kept a secret?

Organizations must consist of all related fields in Federal, State and local governments and various institutions. If an entomologist or plant pathologist goes it alone he is almost sure to find himself in trouble with soil conservationists, public health units, game and fish authorities, economists, agronomists, governors, legislators, congressmen and many others, and last but not least the taxpayers.

Before we can or should approach appropriating bodies for the needed funds considerable practical and fundamental information must be available. We cannot take anything for granted when appearing before appropriating bodies and it is important that the workers, as well as the leaders, supervisors and principals know the whole situation in detail. How can we justify financing if we do not know the needs and any or all possible effects of what we plan to do, far-reaching or otherwise?

Surveys must be established if they are not already an important feature of the functions of an organization; surveys for the pest itself as well as many other items.

Surveys must be conducted to determine the facts of infestations. Where is it and how much is there? Surveys involving the biology of the pest, biological control, its parasites, natural enemies, etc., must be made. Surveys to determine potential damage to the crops or goods that might be damaged must be made. We must know the terrain of the fields, the forests. We must know something about the lakes, streams and the areas of human habitation. We must carefully study available control materials. It is not good enough only to know what is to be used but where is it and what are the available supplies and how quickly can these materials be brought in. Delays in materials have cost us millions of dollars of losses in crops. How are these materials to be stored, handled and distributed? Does the entomologist in charge of a control campaign realize, for example, if the problem is serious and extensive that he should obtain the assistance of the best traffic expert possible? Information should be continually available as to the availability of the

equipment, tools, ground machinery, aircraft, etc. Seemingly unimportant, but tools and minor equipment might well seriously hold up control procedures. Surveys are an important answer to determine availability of manpower, labor, etc.

The economic aspects of the program must be carefully studied, both direct and indirect effects on the economy in the area. All possible damages, damage to plants, animals, industries and, in some cases, the tourist trade, should all be considered as well as the effect of toxic materials to be used on plants, animals and soil.

What do we expect to save, if anything, in a control campaign? Appropriating bodies want to know these estimates and facts before they give us money. What are the values of the crops or goods at stake?

If possible, it is a good idea to know in a general way at least, if there is any "good in the bad" so far as the effect of the activities of the given species is concerned. How should control activities be restricted to certain areas? How much is it going to cost and how long will control measures be necessary?

Are quarantine restrictions necessary? What local, State or Federal laws, rules or regulations are necessary both for entry and operating?

What educational facilities are available and how quickly can we alert the general public to be affected immediately?

RESEARCH - Knowledge gained through research is basic to the establishment of the soundness of control or eradication measures and research, therefore, should be encouraged in every way possible.

When an emergency requires the establishment of control or eradication before satisfactory biological data are available, effort should be made to encourage and aid the extension of the fund of knowledge as rapidly as possible, in order that the procedures may be made more efficient. The need for research, however, should not be permitted to delay the establishment of control or eradication believed by authorities to be desirable, thereby jeopardizing the objective that might otherwise have been attained. Let me emphasize that too often we have had the cart before the horse. Research should be sought and established in connection with control or eradication just as soon as possible.

I realize that in most instances temporary control in order to get a project under way must be set up at the expense of other projects. Any organization should be prepared for such emergency. Here is where the advantage of broadly trained personnel proves to be of extreme value.

Committees of all kinds must be organized in order to maintain proper relations and understandings. Just a word of warning here, however,

watch the advisory committees. Much better, consulting committees. Why? Because too many bosses can wreck a project.

What appropriating bodies must be met? Where are they if the project is Federal, State or local? If an emergency appropriation must be made, do we know where to go? It is evident, of course, that appropriating bodies should be consulted at the earliest possible moment with as many preliminary facts as possible. What are the political involvements? The possibility of political involvements can be serious as some of you know. Do we know how to proceed to obtain the cooperation of all the organizations necessary to support our financial and other needs?

I cannot too strongly stress the need for the student to know the principles of plant quarantine as adopted by the national and some of the regional plant boards.

I realize that I have not dealt strictly with this subject as such, "Training of the Applied Entomologist." By way of implication at least, I believe I have pointed out to you a few simple but extremely important examples of procedure which a trainee should know before he is fit to assume responsibility in his chosen field of pest control. When a student leaves his academic training and moves into a job he can expect anything to happen in this world of insects and plant diseases. The things I mention here I have learned through years of experience dealing with control campaigns on the local, state, regional and national levels. I can definitely say that any one or more of these simple items have been responsible for the success or failure of a part of entire control or eradication campaign.

If an entomologist or plant pathologist, or his teacher, thinks he can go it alone in any kind of pest control campaign, no matter how good he is in his specialization, he is making a vital mistake. He must call on every possible assistance from related fields such as industry; related professional skills such as the engineer, the economist, the conservationist, and above all the best business executives available. He is not expected to be expert in these important disciplines but he can realize the importance of them.

Is the trainee capable of making decisions when he leaves his academic work, or his training program or is he still going to be in the whorl of indecision and uncertainty in spite of his seminars, discussions, etc? This is the acid test which we must apply to our training program. If it can be answered in the affirmative, our educational program is serving its purpose.

TRAINING FOR CAREERS IN APPLIED ENTOMOLOGY

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Entomology is a basic biological science closely related to zoology and botany. Entomology is an agricultural science like agronomy and horticulture. It differs in being its own basic science.

Each of these statements is true. It is difficult to put both into practice at the same institution and at the same time. Because of the two approaches, it is impossible to develop a basic curriculum for entomology across the board.

Plant Quarantine can use men from biology. Plant Pest Control probably requires men trained in agriculture.

The Master of Science degree is coming into its own as a terminal degree. It replaces the old, long undergraduate major. At the University of Arkansas, the Master of Science will have about 27 hours course work in entomology, combined graduate and undergraduate. Most of them enter graduate work in Entomology from the field of General Agriculture. The advantage over undergraduate major with 25-30 hours are:

1. Broader training in related fields - almost a year.

2. A more mature viewpoint and an understanding of entomology and of science because of seminar, thesis research, work experience, and the "graduate" approach.

Plant Quarantine and Plant Pest Control should recognize that the source of Bachelor of Science candidates is drying up because of Master of Science competition and change their recruitment practices accordingly.

Recruitment

1. High school students must be interested in biological sciences and agriculture. Can Plant Quarantine and Plant Pest Control field personnel help with high school science clubs, Boy Scouts, 4-H, and Future Farmers of America?

2. There are numerous junior and other small colleges. The trend appears toward students taking at least their first two years of college training in such institutions. Most of these small colleges do not offer courses in entomology. Course offerings in science are usually limited. If a good course could be offered at the sophomore level in a junior college, it might prove attractive and suffer little from competition.

Most small colleges do not have faculty qualified to teach entomology. The biology department may be limited to one or two teachers with no training in entomology.

Many entomologists in the Agricultural Research Service are stationed in cities with small colleges that offer no entomology. Would it be possible for the ARS entomologist to volunteer his services, for a small fee, to teach a one semester, three-hour course in entomology?

An expansion of teaching of entomology at the junior college level offers the best short-term solution to the problem of shortage of entomologists.

3. College students in agriculture automatically are oriented toward agronomy, animal industry and vocational agriculture unless influenced by 4-H. This is more often habit than interest. To reorient them toward entomology through offering good courses alone is difficult. To reorient any number requires a work program. Through cotton scouting and departmental work, the University of Arkansas, Department of Entomology, places 100 boys for the summer. Nearly all develop some interest in and a friendly feeling for entomology. We don't expect or want them all to be entomologists. Out of this program are graduated 30 to 50 men each year who meet the requirements of Plant Pest Control and Plant Quarantine.

   Few colleges have a work program of this magnitude in entomology. The summer training program of the Agricultural Research Service should make a definite contribution. It is hoped that Plant Pest Control and Plant Quarantine will participate and share the benefits.

4. Most students do little career planning. A few weeks before graduation they start job hunting. There isn't time to fill out Form 57, take the examination, get on the Civil Service register, etc. They should be contacted in person and made definite offers.

Summary

Entomology is taught as a basic biological science and as an agricultural science. This presents a problem in curriculum planning. The number of Master of Science candidates has increased greatly. The Master of Science largely has replaced the undergraduate major. It is a terminal degree, in most cases.

To meet the shortage of entomologists:

1. All entomologists should volunteer their services with Boy Scouts, High School Science Clubs, 4-H Clubs, and Future Farmers of America groups to interest more high school students in careers in science, not overlooking a small plug for entomology as "Queen of Sciences".

2. Teaching entomology in small and junior colleges would attract many students early in their college careers.

3. Summer work programs are essential if senior college students are to be attracted to careers in entomology.

4. College students do little career planning. Many are lost to the Agricultural Research Service because of the red tape involved in qualifying. When the student is ready for a job, he is ready for a job.

TRAINING FOR A CAREER IN APPLIED ENTOMOLOGY

Bailey B. Pepper
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Never in our history have we faced such a golden opportunity for employment and advancement in the field of science and agriculture is no exception.

Before we can logically and adequately evaluate a training program for students in applied entomology, it is essential that we have the students to train. Unfortunately, the colleges and universities are not getting sufficient numbers of students in agriculture to fill the present needs. A good indication of how critical the situation is and how it is getting worse rather than better may be found in the Proceedings of the American Association of Land-Grant Colleges and State Universities 69th annual convention, 1955.

Year	Per cent in Agriculture	Degrees Conferred
1951	11.96	8,264
1952	11.36	8,078
1953	9.93	7,057
1954	9.36	6,419
1955	9.18	5,890

The impact of these pessimistic figures is even greater where it is recognized that about 25 percent of our graduates do not remain in the agricultural fields. It is believed that the fields of entomology and plant pathology are fairly represented by these general figures for agriculture. The present demand for agricultural students is about 15,000 per year and the institutions are graduating a mere 6,000. On the other hand, the colleges and universities appear to be greatly concerned about the expected phenomenal rise in student enrollment during the next few years. Based on population increases alone, the Education Policy Commission recently estimated that by 1960 college enrollment would reach 3,221,000, almost a half million more students than in 1955. The 1965 enrollment was estimated at 3,953,000, an increase of 40 percent over that in 1955. These are challenging predictions. What share of these expected enrollments will the colleges of agriculture get? More specifically, what may be expected in the way of increased enrollments in entomology, plant pathology, nematology, etc.

In the majority of cases, such departments embracing the agricultural pests come within the jurisdiction of the agricultural colleges. If we are to expect increased enrollments in these specific departments, we must also expect the same proportional increase in all departments within these colleges, generally speaking. That being the case, we might ask

ourselves the question, is the agricultural college recruitment program sufficient? If not, what can be done about it?

In view of the overwhelming competition from engineering, chemistry, physics, medicine and public health, business, etc., for competent personnel for job opportunities, agriculture (and I refer to all phases concerned) has done a miserable job in comparison. This failure does not rest solely with the colleges and universities, but with industry, government and all other agencies concerned. Too often we see press releases and hear newscasts extolling over production of many agricultural commodities. We also see many news releases praising outstanding research accomplishments or agricultural achievement. But seldom do we see releases presenting the basic facts of agriculture's shortcomings--many unsolved problems with limited technical personnel and inadequate funds. This situation is due in part to our dependence upon the Congress of the United States and the State Legislatures for public funds. We have many problems facing us and it is our responsibility to present our needs and our opportunities in agriculture in such a way as to attract our young people into the field. All of us concerned well know that agriculture is more than plowing, milking, mowing hay, etc., but do the boys and girls who graduate from our high schools know it? What percentage of the youth and even the adults of America know the meaning of the word entomology?

There is so much that could be done to enlighten not only the high school boys and girls but also the parents, grandparents, aunts and uncles, regarding the opportunities in entomology, as well as all other subject matter areas in agriculture.

Yes, we must admit that much has been done in the past and much is being done now, especially through extension channels, but we are not keeping pace with other fields. Each and everyone here today has a very real responsibility in recruitment, training and employment of competent personnel in plant pest control and other areas of agriculture.

We would be remiss if we do not consider briefly at least, the quality of the present day students and/or graduates. W. H. Garman, Chief Agronomist, National Plant Food Institute, Washington, D. C., before the Agronomic Education Division, Student Activities Section of the America Society of Agronomy, Cincinnati, Ohio, November 13, 1956, said:

> "In my opinion, our basic deficiency in training today does not lie in our colleges, but rather in our high schools. The bare fact is that we do not have enough qualified teachers in mathematics and science in our high schools. And until the salaries of our teachers are very greatly improved, we will be confronted with this situation.
>
> "All too many of our high school teachers are trying to teach mathematics, chemistry, and physics without even the basic fundamentals at their disposal.

"Largely responsible for this is our training program for teachers. Major emphasis in these programs is placed on courses in education which have as their objective 'how to teach' rather than 'what to teach'. Unless one takes a certain number of college credit hours in teaching methods, he is not eligible to teach in a public school. Carrying this a step further, assume that you had a Ph.D. degree from the Massachusetts Institute of Technology in chemistry or mathematics and wanted to teach in a high school here in Ohio. You could not do so without first returning to college to complete a certain number of hours of education. Yet, you would be eligible to get a job teaching at Ohio State University or at other of our leading universities."

Walter Henry Nelson, Newark Evening News, January 22, 1957, discusses in some detail the high school teacher problems and concludes by saying, "Better and shinier classrooms aren't going to help. The fault lies with those teacher's colleges which teach the how of teaching but leave the subject-matter untaught."

Even though some high school graduates fail to meet the entrance requirements for college and probably some college freshmen and sophomores have to withdraw because of poor marks, our own experiences show that entomology majors at the undergraduate level and our graduate students are equal, if not superior, to students of 5 or 10 years ago.

So much for procurement of and standards of students. Now let's look at the question of training students for a career in applied entomology.

I personally would prefer to delete the word "applied" and talk about training for a career in entomology. It would certainly be easier because I frankly do not know exactly where basic entomology ends and applied entomology begins. Several excellent articles have been written on the subject by outstanding teachers and professional leaders, but in most instances the authors' views are slanted in a specific direction. Too often personal opinion is expressed rather than the facts. Seldom does one find the philosophy of the students presented in the discourses on training for a career in entomology. Those of you who have attended the annual meeting of the Entomological Society of America in the last three or four years have heard, I am sure, individuals, as well as groups, expound on the question of professional status for entomologists. I, personally, have not heard two entomologists that could agree on minimum requirements for professional status or rating. So far it is a free-for-all argument presumably depending upon the philosophy of the individual and that of his major professor. I, therefore, recognize that I may not receive unanimous agreement on what I have to say. I do believe, however, that we can agree on certain basic phases of the training or educational program.

I believe that we can agree that in the college program the student as a component of our society is the first consideration. Every effort must be made to see that the student gets the essentials necessary for good citizenship; for a useful person to his country and to his community and for a rich personal satisfaction. This we might refer to as a liberal phase of education, including the humanities, and social sciences. Secondly, I believe we can agree that basic courses in the biological and physical sciences are essential. There would be some disagreement, no doubt, in the number of credit requirements such basic subjects as mathematics, chemistry, physics, zoology, botany, bacteriology, and geology should entail. With these basic considerations mastered to a reasonable degree, at least, we would expect the potential employee to be proficient in the spoken and the written word, able to meet his fellow man and win his respect professionally and socially; and above all be able to teach the public the importance of his profession -- entomology.

General vs. Specialized Training

As one examines the college catalogs of entomological programs he finds two extremes and all sorts of modifications in between. These extremes are (1) specializations in entomology with little opportunity for the student to get much training in the humanities, social sciences, arts and the basic biological and physical sciences; (2) general coverage of the basic sciences (mathematics, chemistry, physics, botany, zoology), humanities, social sciences, allied fields and limited entomology courses. Our program at Rutgers falls in the latter category. Our philosophy is that we cannot adequately train an entomologist in four years of college work, but during the four undergraduate years we can give him a basic foundation upon which we can build a sound and effective entomology training at the graduate level. We think our undergraduate program has been very successful, as demonstrated in our graduate program and in that of several other universities. We have, however, had some criticism from other universities because the Rutgers students did not have enough entomology but instead had a "lot of bunk" (meaning 3 years of chemistry, 2 years of mathematics, 1 year of engineering, physics, geology, bacteriology, plant physiology, etc.) which was of no use in entomology. Although our department cannot compare with some of the larger universities in numbers of graduate students, we have had students from a wide geographical area and some with specialized training, as well as some with a general training. Of course, one never gets two students alike, but generally speaking it has been our experience that the specialized student with detailed knowledge of entomology does not know what to do with it after he has memorized it. Those with the fundamentals usually soon surpass the specialized student in all respects. Specialization has a definite place for the student who has no desire or intention of continuing his education after four years of college. Unless the undergraduate student expects to enter a graduate school then some of the basic courses may be by-passed and entomology and allied subjects substituted. Such a decision must rest entirely with the student, since the university or teaching administration has no professional or moral right to decide the issue.

The question is often raised by prospective employers, particularly by industry representatives, why not require the student to take more courses or credits in the undergraduate program? The answer is quite apparent. In many of the Land-Grant colleges the credit load is now considerably larger than the requirements in the liberal arts colleges. At Rutgers we are studying ways in which we may reduce the freshman load below 21 credit hours per semester. So far, no solution has been found.

In a recent survey of agricultural colleges in the northeast and some in the middle west it was found that the semester credit hour requirement for the Bachelor of Science degree ranged from about 125 to 145, exclusive of physical education and military science. With current credit levels, there is little that can be added if we expect students to participate at all in extra-curricular activities. Regardless of whether a specialized or a general program is pursued, the learning process absolutely must continue beyond the Bachelor of Science degree either on the job or advanced studies. The entomologist today who does not continue to learn is doomed to a static position.

Because a student specializes or pursues a general program does not insure ability to do qualified work at the graduate level. Those that do not qualify for advanced work might consider further specialization as a special student in the undergraduate college. There are, however, good arguments pro and con regarding the question of trying to develop a qualified product in applied entomology in the regular 4-year college program. I, personally, strongly feel that a general basic program is the most appropriate procedure for the majority of qualified students. If they have "what it takes" they will specialize in entomology on their own or under an employer training program and at the graduate level should they wish to continue their formal education. Entomology students can learn entomology on their own much more easily than they can learn the basic subjects, such as chemistry, mathematics, etc. I cannot accept one of my colleague's arguments for specialization when he writes, "Finally, the actual need of courses in agriculture is questionable since experience has shown that the fundamentals and the practical details necessary to the entomologist in his investigations in agricultural entomology and his recommendations for insect control are easily and quickly acquired in the course of early professional duties through conferences with and advice of cooperating agricultural specialists."

This is far from the fact.

In preparing this talk I took the liberty of reviewing several papers on the subject, as well as some in related areas. I am somewhat horrified at rather brazen disregards for the conservation of our youth, or in other words our human resources. In many instances the philosophy is, "fill

the position regardless of the requirements other than those specified by the statutes". Little or no consideration has been given to the potentials of the person placed in the job. I am confident that for entomology to prosper as a profession we must gear our educational or training programs so as to develop to the utmost the talents of our students.

The teachers have a tremendous responsibility in the training program. In addition to teaching the student he must also study and learn first hand the make-up and idiosyncrasies of the student. This is necessary for the teacher to guide the student in the direction of his greatest talents. The student today is the teacher, the researcher, the regulatory official and the administrator of tomorrow. Our colleges and universities are actually responsible to the students for without students there would be no such institutions.

In conclusion, may I say that I have a very strong conviction that the training program is a 3-way deal: (1) the student must make the sacrifice and have the desire to learn; (2) the teacher and the college must accept the responsibility of teaching the student the fundamental and applied sciences and other essentials; and (3) the employer, plus the student, must accept the responsibility of on-the-job specialization for the specific position.

TRAINING IN CROPS REGULATORY PROGRAMS

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U. S. Department of Agriculture

Program Responsibilities; Crops Regulatory Programs

On-the-job training is characterized by its direct correlation with the job to be performed. In connection with crops regulatory programs, the responsibilities may be summarized as follows:

1. Establishment of defense lines to prevent introduction of foreign plant pests.

2. Protect the mainland against the spread of plant pests from offshore possessions.

3. Provide phytosanitary certification service for growers and shippers of domestic products offered for export.

4. Under general and special authorization and in cooperation with other Federal, state and other public and private agencies, as appropriate, conduct programs to eradicate, suppress or control insect pests, plant diseases and noxious weeds, including new introductions which may have become established in limited areas within the United States.

5. Combat insects or plant diseases which occur in emergency outbreaks and require organized control effort over wide areas.

6. Provide leadership for nation-wide insect survey to furnish a basis for forecasting insect outbreaks and advising industry and farmers as to the kind and extent of controls needed.

7. Administer the Insecticide, Fungicide and Rodenticide Act of 1947 and the provisions of Section 408, of the Federal Food, Drug and Cosmetic Act as amended by Public Law 518, providing for certification with respect to certain pesticide chemicals for which tolerances or exemptions are sought.

Reliance on Professional Personnel

The effectiveness of survey, control and regulatory functions of Crops Regulatory Programs rests squarely with program management and the field

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personnel "on the line". Function management recognizes not only its responsibility for sound program conception, but the basic dependence on field personnel for supervision, maintenance of a productive work force, and a level of employee job performance adequate to program demand.

This recognition in the area of job performance is reflected, in part, in the qualification standards set for employment. For specialized positions, emphasis is placed on college level, academic training in specified biological or agricultural sciences leading to a Bachelor of Science degree or a combination of academic training and field experience. It is further reflected by the use of in-service and on-the-job training for new employees and to provide experienced employees with an opportunity to improve skills and prepare for advancement. Educational opportunities are available through the Graduate School of the Department of Agriculture, use of Department libraries, and through a liberal leave policy for those who want to return to school. Non-standard tours of duty may be assigned, under prescribed conditions, to enable employees to take advantage of courses offered at high institutions.

Training Responsibility

Departmental policy specifically states that "employee training will be maintained as a means of promoting effective and economical service. The training will be designed to help the employee become adjusted to his situation, to render optimum service on the job in terms of mutually understood standards of performance and accomplishments, and to help him prepare for broader service and for advancement to work of greater responsibility. Development on the job of the abilities of employees is a major responsibility to be shared both by employees and those who supervise their work".

The Training Need

Training in certain skills, techniques and subject areas, characteristic of Federal government activities is not widely available in the colleges and universities.

A. Biological Aspects

The constant, methodical inspection of plants, plant products and carriers, particularly from foreign sources, has greatly expanded our knowledge of the variety of plant pests encountered in world commerce[1]. Research in the allied biological sciences, at home and abroad, has provided the regulatory worker with additional information on the detection, biology, identification, distribution and control of plant pests. While emphasis on specific plant pests is necessary for biological substantiation of quarantine restrictive measures, the statutory framework relegates authority

to the enforcement agency to concern itself with designated plant pest groups. These groups include insects and other arthropods, snails, nematodes, fungi and bacteria, viruses, and similar allied organisms which can directly or indirectly injure or cause disease in plants or plant parts.

Dependence on the inspectional procedure particularly with plant product imports, as the only practical means for providing plant pest protection and maintaining the trade flow without serious dislocation, demands that personnel charged with inspection possess the necessary information on detection, identification and host relationships in the pest groups involved. Mitigation of the inspectional problem is achieved, in some instances, by regulatory devices involving prohibitions, phytosanitary certification procedures, mandatory treatments of products and establishments, pre-inspection in country of origin and post-entry growing under supervision and control. Some of these methods are necessary for those plant pests not readily detectable at the time of host entry. However, it is evident that the inspection procedure is utilized, even here, but at a more opportune time. Aspects of the inspection procedure have a direct bearing on training needs. Survey, sampling and inspection techniques, host recognition, detection and identification of plant pests, and selection and supervision of approved treatments and cultural practices, when applicable, constitute the more important training areas in the biological field.

Typical of these training needs is the identification of plant pests in connection with the inspection procedure. The variety of exotic and indigenous forms encountered[2/] represents a considerable problem in detection and identification. Insects associated with plants and plant products are commonly represented by the immature stages. The recognition of the immature stages of those orders, family groups and specific forms associated with such products in commerce is a necessary function of effective plant quarantine enforcement. Training in recognition based on taxonomical characters, host relationships and pest distribution is essential to adequate pest protection and public service.

B. Legal Aspects

The framework of law, regulations and procedures constitutes the limitations placed on enforcement. Knowledge

of these limitations is essential to effective job performance on all levels. Crop regulatory agencies administer the provisions and regulations of twelve basic plant pest acts and resolutions. Cooperative enforcement involves many other Federal and state regulations and the import requirements of foreign countries. Under the Plant Quarantine Act of 1912, as amended, the regulatory agencies enforce the provisions of twenty plant quarantines and orders against foreign areas, seven plant quarantines against offshore possessions and ten domestic continental plant quarantines. The need for training, particularly for the new employee is acute and immediate. This training need is not peculiar to the plant pest regulatory field, but is marked in other phases of agricultural law which play a vital role in the planned agricultural economy of the nation. The agriculturists engaged in the segments of our economy which are affected by the regulatory laws must assume the leadership necessary for the high level of public compliance required. Preparation for this leadership should be a considered phase of their academic background.

C. Orientation

The third area of required in-service training is the field of orientation and public service. Employee indoctrination includes the main objectives, functions and organization of the Department of Agriculture, Agricultural Research Service and Crops Regulatory Programs. Federal and state, inter-agency, public and employee relationships pertinent to plant pest protection programs are necessary areas of study. Information essential to the employee as to his obligations, privileges, and the administrative regulations affecting his health, welfare, career opportunities, and so forth is covered.

The Training Programs

Training in the areas outlined above has been carried on for many years, principally through the medium of the apprentice method of on-the-job training. Field schools were conducted for large numbers of new employees to meet program demand of an emergency or limited scope. Shortly after World War II, impetus was given to the intensive short course and workshop methods of training. The short courses combine formalized academic instruction with supervised field practice.

Training is an integral part of the programs of the Plant Pest Control Division. It is conducted on an informal basis although it is based on a definite plan with positive objectives. The amount of training that an employee receives depends upon his specific needs and the requirements of the work assignment.

Special attention has been given to the training of the supervisory personnel. In plant pest control, the supervisor is the key to success in carrying out various program activities. Supervisors for the most part come up through the ranks, and promotions to supervisory positions come in recognition of a good record in line jobs. Although there are many facets to the supervisory job, some being more important than others, all are important enough to warrant continuous appraisal because each makes a contribution to the over-all work accomplishment.

The program leaders stress the belief that employees develop and do their best work if given an assignment and adequate freedom to do the job with little or no interference. It is only when employees, through training, experience, and conscientious effort become capable of assuming additional responsibility that this philosophy becomes productive.

With this thought in mind, the Plant Pest Control Division is engaged in a recruitment and training program to provide for filling positions vacated by retirements, resignations, reassignments, and promotions. The Division recognizes the premise that management does not develop its people. It can only provide, in reality, a favorable situation in which employees of a work-unit are stimulated to develop themselves within the limits of their individual capacities.

Although it is not possible for every employee to participate in a formal training program, every employee is given an opportunity for self-improvement. Each individual can develop a program which will not only improve his present work, but will also strengthen his qualifications for more responsible assignments within the Division.

The Division is engaged in a program to assist supervisory employees by (1) providing work assignments on all phases of Division program activity, (2) encouraging supervisors to hold training sessions periodically throughout the year, (3) providing opportunities for on-the-job training, (4) furnishing selected reading and reference materials, and (5) giving guidance for starting new employees when they report for duty regarding such items as (a) job instructions (including principles that apply to the program), (b) references for broad Division and Department orientation, (c) on-the-job training in related program activity, and (d) follow-up coaching on the part of the supervisor.

Each new Division employee is given instruction in the basic subject matter pertinent to the assignment that he will have. His first weeks on the job are spent learning methods and procedures while at the same time he is engaged in productive work. Each is thoroughly oriented in the work of the Division, the Agricultural Research Service, and the Department.

Each program holds yearly workshop type training sessions to review new methods and procedures, the use of new insecticides, etc. These may involve the entire staff or just special small groups that are concerned with specific aspects of program activity.

The Plant Quarantine Division has established a training center at the port of entry at New York for conduct of short courses. The staff of the center is drawn from the ranks of experienced Division personnel who have a demonstrated background of instructional aptitude. The facilities of the center include plant pest specimen collections, plant product exhibits, visual aid equipment, and demonstration materials. Facilities are provided for a maximum of twenty-five participants. Several of the courses conducted in the center have been accepted for credit by the Graduate School of the Department of Agriculture.

A. Basic In-Service-Training for Plant Quarantine Inspectors

At the present time the center is conducting a basic training program for new employees. The course is organized on a twenty-six week period of continuous training. The first twelve weeks of the program include orientation, indoctrination, and the academic phase. In addition to intensive classroom and laboratory instruction, this early period is utilized for field familiarization, public relations, employee relations, personnel conferences on training, the new job, the new environment, and so forth. The principal aim is to bring the new employee as close to his new job as possible, encourage his broad understanding of the functions of the agencies involved, and prepare him for the intensive training period. The basic program covers the major training areas previously discussed. These include orientation, legal aspects, inspection procedures and treatments, biological aspects (with emphasis on applied entomology), and the final fourteen weeks on supervised job assignments as the practice area.

Entomological Training

The portion of the program dealing with plant quarantine entomology takes approximately five weeks. The training is concerned with two major objectives. The first is to familiarize personnel with those plant pests designated in the regulations or determined to be of significance, their host relationships and foreign distribution. The second consideration is the study of family diagnostics of the immature forms commonly encountered. Particular emphasis is placed on those which are primary pests of the growing crop, or found with plant products moving in commerce. Line inspectors handling host imports, for example, must be able to distinguish larvae of the Tephritidae from those of the Drosophilidae, Otitidae, and Muscidae as the preliminary requirement in the disposition of the shipment. Further determinations are necessary before the final disposition can be effected. Similar problems exist in the orders of Lepidoptera, Coleoptera, and Hymenoptera. Other orders studied include the Thysanoptera, Isoptera,

Orthoptera, and Hemiptera. The study program is evenly divided between lectures, demonstrations, and actual laboratory exercises in the recognition of insect plant pests. Extensive use is made of transparencies depicting insect stages and infested host materials, mimeographed material, motion picture films of indigenous pests of a related nature, and a large collection of preserved foreign plant pest material for hand lens and microscope study. Several illustrated keys especially prepared for plant quarantine work are provided, and in order that the trainee be able to effectively utilize these, anatomy and taxonomy of the groups studied are closely correlated. The center has received considerable assistance from the specialists in the Identification and Parasite Introduction Section, Entomology Research Division, through their participation in the training programs, review of the prepared material, and contributions of training aids.

Trainee Appraisal

Periodic written examinations and oral reviews are conducted during the training period. These examinations are designed to test the trainee's study habits and progress, and emphasize the relative importance of the training material. Supervisory evaluation of the individual trainee is made during the fourteen weeks of rotated job assignments. The basic program constitutes the first six months of the probationary period for most of the new appointments in the Division. The program minimizes the time necessary for the new inspector to assume the full duties of his position and increase his early effectiveness in the Division.

Retention in Service

The training program is an integral part of the Division recruitment plan. The new employee appointed as a GS-5 ($3670 p.a.) trainee inspector to the Training Center at New York, upon successful completion of the six-months' course, advances to grade GS-7 ($4525 p.a.) and may receive 10 credit hours in the USDA Graduate School. After serving one year in further on-the-job training at a location to which he is transferred at government expense, if he is qualified for further advancement, he can be reallocated to an available journeyman inspector position in the GS-9 ($5440 p.a.) grade. Failure on the part of the trainee to satisfactorily complete the basic training period will result in his separation from service.

B. Training Center Short Courses

In addition to the basic in-service course outlined above, the center conducts short courses in plant quarantine

entomology, plant quarantine pathology, and plant quarantine nematology. The short courses mentioned, with the exception of the recently developed nematology program, are accredited with the USDA Graduate School. All courses are conducted during regular business hours but require considerable outside study efforts by the participants. Courses are offered and conducted in accordance with Division program needs, budgetary requirements and availability of personnel. Over one hundred Division personnel have been processed in the formal short courses at the center.

Additional Training Areas Considered

Formalized training is being considered in the biological field on the subjects of acarology, quarantine botany and the use of pecticides and other treatments applicable to plant quarantine enforcement. The projected program includes consideration of supervisory training and workshops to supplement career ladder development within the Division.

Training of Foreign Nationals in Crop Regulatory Functions in the United States

Two special short courses in the regulatory and control aspects of plant quarantine and plant protection are available to foreign technicians. The Plant Pest Control Division conducts a special program and training tour on grasshopper problems centered at Denver, Colorado. The Plant Quarantine Division, at its training center in New York, conducts a 3-months' short course in plant quarantine and plant protection. The latter course includes the control aspects of plant protection and is offered three times a year.

Most of the foreign participants are sponsored by the International Cooperation Administration, State Department. Training programs and itineraries are developed jointly by that agency, the Foreign Agricultural Service, and the Agricultural Research Service (Office of International Relations). Programs are designed to meet the needs of foreign participants in their specialties or fields of interest.

Scope of Course

The training programs are designed to assist foreign participants in the implementation of plant quarantine regulations in their own countries, resolution of problems connnected with such programs, and further the exchange of technical information. In the courses given, field programs are arranged which include visits to plant quarantine stations, control operational units, and facilities of other agencies of the Department of Agriculture.

Assistance Rendered

Since the beginning of these formalized training programs for foreign nationals in 1952, a total of thirty-nine participants from twenty

different countries have completed the short course. The USDA Graduate School awards a certificate to the participants who satisfactorily complete the program. In addition, there have been many foreign participants visit crop regulatory facilities.

Evaluation

The foreign visitors have been most helpful to the Division in several respects. Literature on the economic plant pests in their countries has been received and participants have translated and interpreted import regulations of their home countries. These viewpoints expressed by the technician materially assist the Division in rendering effective export certification. Contact is still maintained after the participants have returned to their home countries.

Training Abroad

Assistance is rendered the United States Operations Missions of the International Cooperation Administration and the governments of cooperating countries in the development of practical insect control programs and the establishment of phytosanitary services. United States crop regulatory personnel have been designated to assist in such programs in Lebanon, Iran, Pakistan, Iraq, Libya, Indonesia, and Central America. The major objectives have been: (1) to aid the governments of cooperating countries in the development and direction of practical control programs against major insects; (2) maintain facilities and services for a coordinated locust control program in the Near East, Africa and South Asian countries; (3) to train nationals in aerial application of pesticides and plant protection procedures; and (4) to aid USOM in developing coordinated insect control programs in the various countries.

Accomplishments Abroad

New equipment, including 40 spray planes, 67 trucks, 241 power sprayers and over 7,000 hand-operated units were imported by cooperating countries. Fifty-two pilots were trained for spraying and dusting, 19 mechanics for maintenance and 125 men received training as plant protection officers. Assistance was rendered to the OIRSA organization in Central America in the implementation and conduct of a training program for Central American plant quarantine inspectors at the Interamerican Institute of Agricultural Sciences at Turrialba, Costa Rica.

It is believed that the successful establishment and enforcement of plant quarantine practices and control procedures abroad will strengthen the agricultural economies of the country concerned, and will also be reflected in the quality and variety of goods offered for export. The program has provided more than an exchange of information between technicians with mutual interests -- it is a warm and sincere experience in the field of human relationships and understanding.

Supplement A

Basic Statutory Authorizations - Crops Regulatory Programs

Insect Pest Act of 1905 (7 USC 141-144)
Plant Quarantine Act of 1912 as amended (7 USC 151-167)
Honeybee Importation Act of 1922 (7 USC 281)
Pink Bollworm Act of 1930 (46 Stat. 67)
Incipient or Emergency Outbreak Resolution of 1938. (7 USC 148-148c)
Mexican Border Act of 1942 (7 USC 149)
Department of Agriculture Organic Act of 1944, as amended (7 USC 150-150g)
Insecticide, Fungicide and Rodenticide Act of 1947 (7 USC 135-135K)
Golden Nematode Act of 1948 (7 USC 150-150g)
Mollusk Act of 1951 (7 USC 441)
Halogeton Glomeratus Control Act of 1952 (7 USC 1651-1656)
Miller Pesticide Residue Amendment to Federal Food, Drug and Cosmetic Act of 1938 (21 USC 321)

1/ Rules and Regulations, 1955; Title 7, Chapter III, Code of Federal Regulations, Plant Pest Control Division and Plant Quarantine Division, Agricultural Research Service, USDA

2/ List of Intercepted Plant Pests, 1954, United States Department of Agriculture, Agricultural Research Service, Plant Quarantine Division, Service and Regulatory Announcements

MEETING EMERGENCIES

Frank A. Todd
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In man's efforts to produce an adequate wholesome food supply, he attempts to protect his livestock and crops from disease. In accomplishing this, he develops and he creates animal populations and food plants that are susceptible to those diseases and insects that he has successfully restrained. This condition exists in most modern countries today. The degree with which it exists depends on the general standards of application of protective measures. In those parts of the world where they have failed to effectively control some of the more devastating diseases of animals and crops, a poor state of agricultural industry exists.

The countries of North America now enjoy freedom from many of the dangerous and devastating diseases of animals and plants found in other parts of the world. Upon several occasions, this country has been successful in ridding itself of some of the more serious and devastating diseases of animals and crops. The programs of eradicating the khapra beetle and more recently the Mediterranean fruit fly are examples of current activities in this field. Our recent experiences with vesicular exanthema in swine illustrates a recent animal plague that called for eradication procedures.

Our present civil defense efforts are devoted towards developing protective measures for ourselves and our possessions from possible enemy attack.

Recently, we have been impressed with the destruction that nature itself rains upon us from time to time with hurricanes, floods, droughts, etc.

We are, now, planning in terms of defense and aid for natural as well as national disasters. Thus, as we develop better means of protection against nature's attack on us with disease, floods, and tornadoes, we are also including plans for protection and survival from the deliberate attempts of man to bring death and ruin upon us.

The country's defense authorities agree that any war of the future will likely appear as a sudden attack on metropolitan and industrial centers with nuclear missiles as the principal weapons and the civilian population as the main target. Defense will consist, not of embattled farmers barricaded behind every fence and hedgerow exchanging fire with advancing land armies, but of a struggle for survival, as a people, in order to back up the nation's counter-blows from military bases here and abroad.

Modern warfare, like disease, is no respecter of persons, boundaries, or localities. It can strike anywhere and affect anyone. Cities, rural

communities, farms, and ranches can feel the blight of any future war. Entire cities can be destroyed. Casualties may be counted in thousands or even millions. If warning time permits, many people probably will be evacuated from urban areas. They would, of course, be directed outward into the rural regions.

The survival problem, when and if we are faced with it, must include the care of large numbers of injured and larger numbers of evacuees whose homes have been destroyed or whose home areas have been made unsafe by radioactive fallout.

One of the major problems will be providing food -- not only for the civilian population but, just as important for our survival, the military. We are all aware of the necessity of an adequate food supply for successfully conducting a war. In the past the availability of food has determined, to a great degree, the outcome of the campaign.

Many of us, especially the persons from the urban areas, forget how dependent we are on the farm for our survival. When we consider the farm or ranch as the source of meat, fats, cereal and like crops, fruits, vegetables, etc., man is almost wholly dependent upon the farm for his existence.

With the modern weapons of war -- the nuclear bomb with its associated radioactive fallout hazards, possible use of biological warfare and chemical warfare -- our rural areas could be very much affected in future world conflicts.

With the potential threat of biological warfare and chemical warfare being used against our agriculture, on September 8, 1954, the Federal Civil Defense Administration delegated the responsibility for the planning of national programs and directing activities concerned with the research, diagnosis, strengthening of defensive barriers, and control or eradication of diseases, introduced as agents of biological warfare against animals and crops. This delegation was made to Agriculture because of its peacetime responsibility. The vast country-wide State-Federal cooperative regulatory programs, with their associated quarantine, survey, control and eradication procedures, provides the basis for an emergency organization and the knowledge required to help combat this potential enemy threat. This same State-Federal combination, with its continual research developing new information, disease-resistant strains of plants, new techniques for surveying improved baits and chemicals for containment and eradication procedures provide us with important tools to help assist the efforts at combatting foreign diseases and pests.

Some of the basic principles of disease control are rather constant, whether you are dealing with diseases of man, animals or crops.

Primarily, the basic responsibility of the Federal government is that of preventing the introduction of foreign diseases and insects into this country.

Next -- if they do gain entrance, to promptly recognize them and report their presence.

The promptness with which the initial infestation or importation is recognized and reported will determine the future action and success of control or eradication.

In dealing with the more serious and devastating diseases of animals and plants, experience has taught us that in the long run it is cheaper to live without them rather than to live with damaging diseases or pests. That is why the regulatory officials, whether in animal disease or plant pest control, are making every effort to prevent the entry of dangerous foreign pests and constantly striving toward the goal of eradication of those that are already here.

Basically it was this philosophy that led to the passage of the Plant Quarantine Act of 1912. With its later amendments, this Act provided for many safeguards against entry and establishment of foreign pests, as well as against the domestic spread of those introduced. The safeguards consist of embargoes and regulatory provisions in both foreign and domestic commerce.

If there were no barriers to plant disease entry, the United States could readily become the habitat for a host of plant diseases which are not now known in this country. There are still many important plant pests in other parts of the world which must be kept out of the United States.

The Plant Quarantine Act is credited with having cut in half the number of introductions of damaging foreign insects. This has been done in spite of vastly increasing commerce, with more and more people and goods moving about the world. Modern transportation brings this country close in time to distant lands -- and to damaging plant pests which imported goods may carry. The speed of modern travel increases the opportunities for the pests to arrive here in a living state.

I think we as Americans have in the past looked upon a number of diseases of animals and crops as problems peculiar to Asia, Africa, Europe, or wherever they happened to be. With the advent of planes and the build-up of international trade and travel today, these diseases considered foreign to the country have taken on a new and an added importance. Even though rigid and very effective precautions are continually in operation to help prevent the introduction of foreign diseases and insects into this country there still remains and there always will remain the possibility that some may gain entrance accidentally.

Therefore, we recognize an ever-increasing need for strengthening our defenses or regulatory organizations to meet the potential threat of our modern world in peacetime as well as during a national emergency.

What are the requirements?

We must, therefore, seriously consider making our survey efforts more comprehensive so that any incipient infestation of an insect or a disease

of plants may be detected while the area involved is small and controllable. Frequently, this would provide an opportunity for eradication at reasonable cost and without serious impact on the industry.

In reviewing past outbreaks of unusual or foreign diseases and insect pests, we find that they have gained entrance and spread by a number of means. In each outbreak, whether it be a disease of plants or animals, we try to work out the epidemiology of the disease and find out the means by which it gains entrance and spreads in order to try and stop or minimize this source of trouble. In every case it is not possible to determine the means by which the agent gained entrance and in those cases we are handicapped in our preventive work.

Important and essential for a successful effort at eradication is the development and establishment of an organization within each state that can promptly take the required action in handling the problem.

In the field of animal disease control, a State-Federal Emergency Animal Disease Eradication Organization has been established in most states. This organization is based on past experiences in handling foreign or unusual diseases and has proved its merit in eradication campaigns. The various activities required for an eradication program are assigned to qualified State and Federal regulatory officials and it is their responsibility to develop the information and procedures. This organization does provide a uniform approach to the problem. One of the responsibilities of this organization is to keep a current inventory of required equipment and materials in the state. It utilizes the services of various agencies and services of the state, such as the National Guard and Highway Patrol for maintaining quarantines; the forestry and highway departments for heavy earth-moving machinery, etc.

To lend strength to regulatory and control efforts, it is becoming more and more urgent that this country develop thorough knowledge of agricultural pest problems that exist elsewhere in the world. Plant pest control officials were able to move so effectively against the Mediterranean fruit fly in Florida, partly as the result of research work accomplished in Hawaii. The information developed in Hawaii was quickly adapted to the Florida situation, permitting specialists to move ahead with assurance that they were doing the right thing.

Much more research, of course, is needed in developing treatments of plants against various infestations. More information on plant pathogens and the distribution of various diseases and serious pests in this and foreign countries is needed for more effective quarantine work. However, in this field as in every scientific field, the need for more technically trained people is great. We urgently need to encourage more talented students to enter the field of plant pathology, entomology, nematology, and botany to try and keep pace with the ever-growing demands of agriculture in the world today. Meetings of this kind should do much to help develop increased interest and inspiration to the young students.

They, of course, provide an opportunity to exchange ideas and experience, and are a source of professional gain for each of us.

Our experiences during the past several years with such problems as the khapra beetle, and more recently the Mediterranean fruit fly, have provided us with experience that can be used and will be helpful in future problems. We know that modern trade and travel provides an ever-present threat of introduction of foreign diseases and pests into this country. We must learn more about such diseases -- their early recognition, means of introduction and spread, prevention, controls and ideally - eradication. We must all cooperate in helping to develop and establish an effective organization that can be utilized immediately and which will minimize the losses that could result from their presence in this country.

THE FIRST LINE OF DEFENSE - FOREIGN PLANT QUARANTINES

E. P. Reagan, Chief
Plant Quarantine Division
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U. S. Department of Agriculture

The Plant Quarantine Division is one of the two divisions comprising Crops Regulatory Programs which, with Livestock Regulatory Programs, constitutes the regulatory work of the Agricultural Research Service.

In the Washington office of the Plant Quarantine Division, a national program to prevent the entry and spread of injurious plant pests is planned, organized, and administered by the Division Chief and his staff. The work is arranged by program sections of which there are four. That which is concerned primarily with plant diseases and the importation of plant propagative materials is assigned to the Nursery Stock Section; that which is concerned with insects and associated pests and with the importation of most plant products for consumption is assigned to the Port Inspection Section; that which is concerned with the importation of cotton, cotton products, and covers, also inspection and certification of domestic plant materials for export, as well as transit inspection at strategic traffic centers of plant materials subject to regulation by domestic plant quarantines is assigned to the Special Programs Section; the development and formulation of procedures, methods, and standards for field use by inspectional personnel; the assembling and distribution of needed technical information to the field staff; and personnel training is assigned to the newly organized Technical Procedures and Services Section. Related activities, including movement of plant materials from the offshore territories and possessions to the mainland, are similarly assigned to the appropriate section. Management matters are handled by an Administrative Officer.

The field work of the Division is performed at the principal land, sea, and airports of entry into the United States, including Hawaii, Puerto Rico, and the U. S. Virgin Islands. At these ports there are one or more plant quarantine inspectors depending upon workload. In California and Florida, the port staffs are largely State employees commissioned as Federal inspectors. In Hawaii and Puerto Rico, the Territorial and Commonwealth employees, respectively, assist materially in the work.

The direction of the work in the field is through area supervisors. There are six geographic areas; namely, the Atlantic Coast Area, extending from Canada to the Georgia-Florida line, with headquarters in New York; the Gulf Area includes Florida Atlantic ports and ports along the Gulf of Mexico to and including Corpus Christi, Texas, as well as ports in Puerto Rico and the Virgin Islands of the United States, with headquarters in New Orleans, Louisiana; the Mexican Border Area is self-explanatory as it extends from the headquarters port of Brownsville, Texas,

to San Ysidro, California, and includes San Antonio, Texas; the Pacific Area includes the Pacific Coast ports, including those in Alaska, and those in Hawaii, with headquarters in San Francisco, California; the Canadian Border Area extends from Blaine, Washington, eastward to the Atlantic Ocean, with headquarters in Detroit, Michigan; and the Interior Area with headquarters in Memphis, Tennessee, includes the interior ports of St. Paul, Chicago, St. Louis, Pittsburgh, Memphis, Atlanta, and Dallas. Other supervisors have charge of specialized phases of the work: (1) the issuance of import permits at the Hoboken Inspection Station and the inspection and treatment of plant propagative material at the same location; (2) the postentry quarantine growing of certain restricted plants pending final release, as well as the point of origin inspection and clearance of bulbs in Netherlands, Belgium, and France; and (3) the utilization of restricted cotton and other covers under approved conditions in lieu of fumigation as a condition of entry.

The program of the Division is diversified. It is conducted under authority of the Plant Quarantine Act (7 U.S.C. 151 et seq.), the Insect Pest Act (7 U.S.C. 141-144), the Mollusk Act (7 U.S.C. 441), the Mexican Border Act (7 U.S.C. 149), the Honey Bee Act (7 U.S.C. 281-282), and the so-called Export Certification Act (7 U.S.C. 147a).

The Division program has for its purpose the prevention of the entry of injurious foreign pests and diseases of plants and the spread of such pests and diseases from offshore territories and possessions to the mainland, as well as the domestic spread of pests and diseases from regulated areas on the mainland of the United States. A very important part of the program is the inspection and certification of domestic plants and plant products for export to meet the plant quarantine import requirements of the countries of destination.

In carrying out this program, plant quarantine inspectors inspect vessels and aircraft from abroad and vehicles and railway cars from Mexico, their stores, quarters, passengers' and crews' baggage, pedestrians' effects (from Mexico), cargo, and mail for unauthorized plant material. They examine importations of plant materials for pests and diseases and, as required, apply or supervise the application of prescribed treatments or other remedial measures.

Extension of first line of defense. Port of entry inspection is the generally accepted "first line of defense". The Division program includes constant efforts to extend that line abroad in efforts to prevent plant pests from reaching the ports of entry. This is accomplished in many ways, some of which are mentioned here. The United States took an active part in the formation of an International Plant Protection Organization having for its purpose an organized international effort to prevent dispersal of destructive plant pests across national borders. This is paying dividends now and greater dividends are expected as consciousness of the problems increases in other parts of the world. The Division has found that exchanges of visits between Division officials

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and officials of the quarantine services of other countries and discussions of mutual problems are highly productive. Working with the International Cooperation Administration, the Division conducts training courses three times a year for selected foreign plant quarantine officials. Improvement in the sanitary condition of foreign plant material reaching the United States that can be attributed to that training may not yet be impressive, but it is resulting in an exchange of pest information and the development of active services in countries formerly with little or no plant quarantine protection. Eventually, the dividends will be large. Another important extension is made through surveys for specific pests conducted by the Division in foreign areas. These surveys are conducted at the invitation of, and frequently in cooperation with, the governments of the areas concerned and have yielded valuable information for the program. Also effective, but limited in each instance to a specific product or product group, are the arrangements developed whereby that product is treated, processed, or otherwise handled under conditions that eliminate pest risk at origin or in transit to the United States. Such arrangements have limitations and therefore are not numerous. They must be surrounded by adequate safeguards. If pests are to be eliminated at origin by treatment, the efficiency of such treatment must be ascertainable by inspection of the product on arrival in this country, or the treatment must be given under supervision of a representative of the Division. A very effective extension of the first line of defense is described in the next paragraph.

Country-of-origin inspection. Annually, since 1951 for the Netherlands, 1952 for Belgium, and 1954 for France, inspection teams are sent to those countries to inspect bulbs prior to shipment to this country. The Division has appraised the results and finds it can do as good a job at point of origin as on the piers in the United States and, considering the cooperative and financial arrangements made with the industry and those countries, at no greater cost. The shippers and American consumers are better satisfied with the shipments because the knowledge of the high level of the United States requirements has been placed at the disposal of the shippers when the bulbs are being inspected in the fields, curing sheds, and packing houses. Advantages accrue from the close association of Division personnel with the inspectors of the phytopathological services of those countries when United States entry requirements are repeatedly emphasized. A similar practice has been followed in a few instances for the treatment of certain fruits in approved plants in Mexico, as a condition of their entry into the United States.

Application of research results. The Division conducts no organized research although it is dependent upon research in several ways. Research workers in other agencies, including taxonomic specialists, make final identifications of unusual pest and disease interceptions. They assist the Division in the preparation of technical working tools and training aids and advise the Division on program matters. Other research workers

develop treatments which the Division can prescribe for application under Division supervision to rid importations of pests and diseases. They are consulted when an emergency situation arises and participate in devising safeguards adequate for the immediate need.

Liaison with and cooperation of other agencies. It would be physically impossible for the comparatively small field staff of the Division to safeguard the currently tremendous volume of travel and commerce against plant pest entry and spread if the other agencies having an interest in such travel and commerce did not give valuable assistance. To mention a few, there is the ARS-Animal Inspection and Quarantine Division staff in ports of entry with whom plant quarantine inspectors work in close harmony. The Post Office Department and Bureau of Customs joined with the Secretary of Agriculture a number of years ago in issuing joint regulations for handling foreign mail packages containing plant material. Post office employees are very helpful in referring to plant quarantine inspectors such packages for inspection, as well as assisting in the procedures covering plant quarantine inspection and clearance in Hawaii and Puerto Rico of parcels destined for the mainland. At strategic traffic centers on the mainland they aid in making transit inspection of mail practicable. The Customs Service has primary jurisdiction over carriers and merchandise entering this country and customs officers are very helpful in baggage, mail, and cargo inspection. So important is this assistance that Congress adds to the appropriation for Division work a large sum for transfer to Customs to enable that agency to assist fully in these safeguard measures, particularly with baggage inspection. Officers of the United States Public Health Service and Immigration and Naturalization Service are helpful at ports of entry. Officers of the Armed Forces also assist. The Plant Quarantine Services of many countries are increasingly important to our programs as they learn our requirements and sincerely endeavor to meet them when inspecting plant material as a condition of shipment to the United States or in satisfaction of some of the United States entry requirements. The relationships with the Plant Protection Division of Canada are highly satisfactory and result in a realistic and economical approach to many of our mutual problems concerned with the entry of plant material from Canada.

While the foreign quarantine program is the first line of defense, it must be harmonized in many ways with programs of the Plant Pest Control Division by daily close liaison with that Division. Problems often arise for which the solution is found only after consideration with that Division. The language of the Plant Quarantine Act indicates that the State plant quarantine organizations have a part in this program and so they do, an important part. The nature of traffic and commerce and the agricultural interests of the individual States have a bearing on the nature and extent of their participation. Various segments of industry cooperate to aid in maintaining this first line of defense.

Thus, the efforts of the less than 400 full-time Federal inspectors are augmented in many different ways while striving against the flood of alien plant pests and diseases continually pressing for admission to this country.

Training of personnel for the work of the Division has now been placed on a formal basis and a Division Training Center is in operation at New York. A bachelor of science degree with a major in entomology, plant pathology, or related subjects is not enough, but it does form a necessary foundation for a career as a plant quarantine inspector. The training program is designed to supplement academic training and to equip the inspector to detect, recognize, and safeguard against exotic pests that may arrive in connection with travel or commerce from abroad. It also provides for advanced work and refresher courses.

Volumes. To give some idea of the enormity of the task of maintaining a first line of defense, a few figures will be helpful. In 1956, the Division inspected 17,500,000 aircraft, vessels, and railway cars and vehicles, the latter from Mexico. It is estimated that automobile traffic from Mexico alone will reach 23,000,000 by 1962 and that aircraft inspections will also show a heavy increase. Baggage inspection amounted to 13,650,000 pieces in 1956 and will increase as travel increases. (Baggage inspection is conducted by Customs with Division participation in the foreign travel field and by the Division for travelers from Hawaii and Puerto Rico to the mainland). Nearly 24,000,000 containers of domestic plant material were inspected and certified for export in 1956 to meet foreign sanitary import requirements, and the trends indicate that the figure will reach 31,000,000 in 1962. These are only a few of the workload statistics which, when analyzed, show increases in workload amounting to as much as 679% for export certification when compared with the 1947 figures. Baggage inspection increased 248% in the same 10 years and air cargo 290%.

Avenues of pest entry. There are thousands of economically important foreign plant pests and diseases that have not yet gained entry to the United States. A study of these and of those which have become established in this country, some since the colonial days, indicates that pests and diseases in or on plants and plant products is the chief means of entry. Diseased and infested plant propagative material is a most effective way of transplanting a pest from its native habitat to a new location here. Soils, particularly surface soils, can harbor pests and diseases and provide a medium for entry - not only soils about the roots of plants or clinging to vegetables, but even soils on the boots of a person who walked in golden nematode infested lands in Europe yielded cysts of the golden nematode, as did mud from a scrap piece of ship's hawser. Adult insects may fly across land borders and plant disease spores may be carried on upper air currents. There is nothing that can be done by the Division to prevent entry of such airborne pests and diseases at our borders, except as neighboring countries cooperate to such ends. However, for a little over 1/2 of 1% of the estimated monetary value of the annual plant life loss in the United States from insect pests and diseases, the Division does much to prevent further entry of pests and diseases.

Authorized importations of plant materials enter under permit. Sometimes, if risk warrants, the ports approved for such entry are limited to areas unfavorable for pest and disease establishment or to those at which

special facilities are available for inspection and treatment. Plant propagative material generally is restricted to ports having facilities for careful examination for pests by specially trained inspectors and for fumigation and other treatment. Most plant material is unconditionally released after clearing the inspection station. However, certain plants from various parts of the world are admitted under a postentry plant quarantine agreement which provides that those specified items shall be grown under plant quarantine surveillance on premises controlled by the importer. During the period of quarantine growing, which is usually two years, the imported plants are examined by collaborating State officials and by the Division for the detection of any pests or diseases that may have escaped detection and treatment when the plants entered. Should such pests or diseases be found, immediate action is taken against them. Material for consumption such as admissible fruits and vegetables, is subject to inspection for pests upon arrival and to treatment before release if circumstances warrant. In some instances, a treatment is a prescribed condition of entry. Certain cottons and covers fall in that category, although in specified circumstances used cotton covers can be released to a mill in the North for utilization under agreement with the mill owner, in lieu of fumigation at time of arrival.

Baggage and personal effects of pedestrians from Mexico and of passengers and crew members of aircraft and vessels, and of trains and vehicles from Mexico are examined in association with customs officers because they are frequently found to contain unauthorized plants, fruits and vegetables and other plant products. During 1956 over half of the quarter of a million interceptions of unauthorized plant material were taken from baggage. Much of this, upon close examination, was found to harbor destructive living pests and diseases, often destined for an area where they could thrive and multiply.

The stores, galleys, and quarters of vessels, vehicles, and aircraft are inspected because they, too, often have plants and plant products that could be the means of entry for pests and diseases.

Other cargo, aside from authorized imports of plant material, is watched by the inspectors for prohibited items including packing material or contaminating plant material that could bring in pests. Ships and aircraft often touch port in the United States with cargo for another country which must be safeguarded while the carrier is in this country to prevent pest and disease escape.

Foreign mail is inspected in cooperation with Postal and Customs Services because thousands of packages annually contain some item of unauthorized plant material, often infested or infected with a pest or disease not known to occur in this country but, like the baggage interception, destined to an area suitable for establishment.

Although this statement is lengthy, it is only a brief outline of the Plant Quarantine Division program, work, and results. Further details may be had by addressing the Division office in Washington.

VIGILANCE FOR PESTS NEW TO THE UNITED STATES - SURVEY

K. Dorward, Head, Plant Pest Survey Section, Plant Pest Control Division, Agricultural Research Service, U. S. Department of Agriculture, Washington, D. C.

The work of the Plant Quarantine Division and cooperating agencies is aptly described as our first line of defense against foreign plant pests, both insects and diseases. Unfortunately, though, we do have those that somehow slip by this barrier, just as in the case of war the enemy sometimes slips through our first-line troops.

The khapra beetle, the Mediterranean fruit fly, the soybean cyst nematode and the witchweed, all newcomers to our country within the past few years, are just examples of the pests we may expect. We know that other plant pests, whether they be insect or disease, will get into this country. Not only do we know this, but we also know that we have within our borders certain insects and diseases which, if they gain entry into other areas would create just as serious a problem as if the pest were newly introduced.

With the knowledge that pests new to this country or to areas of our country will continue to be with us, this portion of our discussion will be devoted to an evaluation of what we are doing to detect these pests.

Pest detection might be defined as one type of survey and all of you have been acquainted with plant pest surveys as long as you have been associated with pest programs. Usually, however, most of our surveys have been concerned with a specific pest or program. One notable exception to this was the survey conducted in port areas in 1943 to 1945 by the Division of Foreign Plant Quarantines. This survey was specifically planned to determine the insect fauna in the vicinity of ports. This particular survey was of limited duration but it did demonstrate that such an intensive survey would bring to light pests not before known to be in the particular area.

Too, we might define as detection surveys those conducted for specific pests in areas where the pest concerned is not known to be. Examples of such programs might be the surveys conducted to determine if the white-fringed beetle is in some area distinctly away from its known distribution. The same type of survey program is conducted in relation to the gypsy moth, Japanese beetle and other pests. A limited number of states conduct faunistic surveys in varying degrees, thus studying all insect species within a given area.

Although brief mention has been made of some of the plant insect and disease detection surveys, it is believed we should review with detail the organizations developed and being developed for the detection of new pests. We should also study some of the equipment and means we have available to detect such pests. We should then ask ourselves how we may better organize to detect the presence of new plant pests.

In addition to the surveys already mentioned and those of a similar nature, skeleton organizations have been developed to bring together those scientists interested in insects and plant diseases into units which will be on the alert for new pests. These organizations draw on Federal, State, industrial and local agricultural workers. Although these programs are designed to benefit our agriculture in times of peace as well as times of emergency impetus was given to their development by the possibility of biological warfare.

Because of the possibility of biological warfare, the Federal Civil Defense Administration in 1950 requested the United States Department of Agriculture to utilize its facilities to carry out certain functions in the National Civil Defense Program--particularly those functions with respect to the measures necessary to protect this country against the intentional introduction and spread of insects and diseases affecting livestock, crops and forests. To facilitate the program the Secretary of Agriculture directed the Administrator of the Agricultural Research Service to assume the major responsibility insofar as the Department was concerned. Within the research service the agencies concerned with livestock, insects and plant diseases were directed to assume the phase of the program dealing with their respective categories. This meeting is concerned with plant pests but it should be pointed out that two similar series of meetings have been held with persons concerned with livestock.

The program that has been developed relating to plant pests is divided into two phases, one relating to insects and one relating to diseases. Although the basic principle of the program on insects and that on plant diseases is essentially the same, the operations are sufficiently different to be discussed separately.

In the insect field there had been in existence a limited observation and reporting program since 1921. However, the number of persons reporting was relatively few and the reports were on a monthly basis. With the desire to do everything possible to determine the presence of insects new to this country or an area within the country, together with the ever-present necessity of keeping abreast of the economic insects known to be in this country, it was felt an organization should be created that would band together all entomological workers for the purpose of observing and reporting currently on our common as well as uncommon pests. State Directors of Experiment Stations, Directors of Extension and the Commissioner, Director, or Secretary of Agriculture were corresponded with to determine their reaction to the possibility of establishing a stronger economic insect survey program. The response to this suggestion was to the effect that everything possible should be done to develop a strong survey program.

A program was thus developed whereby insect information, other than that on special control programs, from within a state would be forwarded to an office designated as the clearing house for such information. The clearing

house was determined by joint approval of the State agencies concerned. All of the 48 States and the three territories of Alaska, Hawaii, and Puerto Rico had designated a clearing house or office by the summer of 1952. The clearing house varies from state to state. In some cases it is the office of a college entomology department, the experiment station entomologist, the extension entomologist or the state entomologist. (A list of the clearing offices is Attachment No. 1.) Contributors of information would be any dependable worker interested in agriculture. Identification of unknown insects would be made at the nearest point to the field possible, i.e., the individual worker, the county agent or if necessary the State College or Department of Agriculture or the specimens could be forwarded to the Insect Identification and Parasite Introduction Section if desired.

Reports from the field are reviewed and compiled by the clearing office and forwarded to the Plant Pest Survey Office in Washington. In many states a periodic release is issued on conditions within the state. The Plant Pest Survey Section compiles the state reports and issues weekly the "Cooperative Economic Insect Report." In addition to the current information on economic insect conditions, special reports on new insect finds are carried, distribution maps are issued as well as other items designed to keep the country informed both on newly found insects and those common to this country.

To further strengthen the detection program the Plant Pest Control Division has entered into cooperative agreements with 29 states by jointly financing one survey entomologist whose duty is to develop the voluntary survey program as well as to actually survey himself. Money for this program was diverted from the service survey program conducted on a small number of insects in a relatively few states. The cooperatively financed program has made it possible to extend the survey to many states not included heretofore.

As previously mentioned, the crop protection program on plant diseases is organized in much the same way as the insect detection program. The foundation is state cooperation with key individuals within a state reporting to a designated State Leader. Each state conducts its own program in whatever manner that best suits its particular situation. The State Leader submits reports to Dr. Paul Miller, Plant Disease Epidemics, Plant Disease Epidemics and Identification Section, Crops Research Division, Agricultural Research Service, who acts as the national coordinator for the plant disease program. (A list of State Leaders on this program is Attachment No. 2.)

Plant Disease Epidemics assembles and publishes news and information relevant to the purpose of the program. Newly discovered diseases and unusual outbreaks are promptly reported. Bibliographies, reviews and articles indicate the significant factors in various plant disease situations, and suggest the important troubles to guard against.

Effectiveness of the Crop Protection Program is materially increased by the activity of the Plant Disease Warning Service conducted by Plant Disease Epidemics to report and forecast the seasonal occurrence of certain diseases of important crops. The warning service is a cooperative organization similar in many respects to the Crop Protection Program, in fact in many states the personnel are the same. It operates constantly during the crop season and the State key pathologists keep in close touch with their cooperators, so that any unusual plant disease occurrence is unlikely to escape notice.

Material is published in one or another of three different places, depending on the urgency of the report and the type of information.

The Plant Disease Courier is designed solely for the Crop Protection Program. It is restricted in circulation to the State leaders and certain other authorized recipients. State leaders are free to use it as background for their programs, but it is not to be quoted or cited. Direct discussion of biological warfare is confined to the Courier.

The monthly Plant Disease Reporter is well known to all plant pathologists. It has a wide circulation and, of course, its contents are not confidential. Nevertheless, the reports may often be of great interest from the standpoint of the Crop Protection Program.

For very speedy non-confidential reporting the mimeographed Plant Disease Warning Service, "Report on the Plant Disease Situation," is used.

As already noted, the individual State programs are basic to the success of the Crop Protection Program. Responsibilities include training auxiliary field observers, such as farmers or other persons who are in a position to help, to watch for and report unusual disease situations; establishing surveys or some other means of early detection; providing for emergency action either by the State's own authorities or, if necessary, by the Federal regulatory or quarantine services; and prompt reporting to alert plant pathologists and agricultural officials within the State as well as in other areas.

Attachment No. 3 illustrates the type of organization developed for both insect and plant disease detection in Indiana. As in the case of the insect detection program each of the 48 States designated a State Leader for the plant disease program.

The organizations which have been discussed are largely made up of interested workers who in addition to their prescribed work program have the added responsibility of being on the alert for pests not common to their regular routine. The next phase of our discussion deals with some of the equipment available for detection work.

In any survey there is no substitute for hard work. The insect net is still one of the principal tools of the survey entomologist. Extreme patience is also required whether a person is on an insect or plant disease survey. Research, though, has continually tried to improve survey techniques and has in many instances made the task easier. It would be impractical to mention all survey methods used, but a review of a few examples which have come to our attention recently might give us some food for thought.

The khapra beetle, one of our new concerns, is a pest which in many cases must actually be dug out of cracks and crevices to determine its presence unless the infestation is such that serious damage is already occurring. The history of the survey on the khapra beetle is that it was found by a pest control operator in stored barley and submitted to the California State Department of Agriculture for identification. After being identified as a pest new to this country, a delimiting survey of storage properties was initiated by cooperating State and Federal entomologists. Although on this continent the pest has been found only in Arizona, California, New Mexico, and the Republic of Mexico, over 42,400 inspections of storage sites have been made in 38 States.

In contrast to the khapra beetle surveys for another newcomer, the Mediterranean fruit fly, employ some very newly developed tools. A Miami, Florida home owner finding larvae in his grapefruit contacted the agriculture editor of a local paper and through the county agent a tentative identification was made by a trained entomologist at the Sub-tropical Experiment Station. The State Plant Board, as well as the U. S. Department of Agriculture, was notified of the find and tentative identification. To confirm the identification, specimens were sent to the Insect Identification and Parasite Introduction Section in Washington. A cooperative State-Federal delimiting survey was started immediately, using the means available, that of physically inspecting fruit. At the same time plans were initiated to bring in traps which were being used on a relative of the Mediterranean fruit fly, the Mexican fruit fly. This was a glass trap known as the McPhail trap and used with a liquid attractant. Long before the find in Florida, research entomologists had been studying attractants, traps, and obtaining other information which might be used in fighting the Mediterranean as well as other fruit flies. From this research it was found that oil of angelica seed was an excellent attractant and could be used in a dry plastic trap. Use of the dry type trap which eliminates the bother with liquids and gives a readily identifiable specimen made it possible for one man to handle three times the number of liquid traps. More than 45,000 of these plastic traps are being used in Florida at the present time. These developments made it possible to survey the citrus area of Florida within a few months after discovery of the fly. Such an accomplishment would have been impossible if the old fruit cutting method had been the only technique available.

Research has made available other chemical and biological lures which strengthened the survey program for specific pests. In the gypsy moth survey program an attractant from female gypsy moth abdomen tips is used for trapping the males. Proven chemical lures have been used in the melon and olive fly surveys. More recently, a synthetic attractant, ENT 20279, although not as effective, has been developed as a substitute for oil of angelica seed, which is becoming very scarce.

Although light traps of various types have been used for many years in insect surveys, it has only been within recent years that ultraviolet fluorescent-type lamps have been found to be very effective as a survey instrument. The Farm Electrification Section, ARS, under the leadership of Dr. T. E. Hienton, has been very cooperative in this study. That section, in cooperation with the Plant Pest Survey Section, has made available approximately 100 traps to 24 states in making this study. It might be added that the Farm Electrification Section, in cooperation with Texas A & M and the Cotton Insects Section, ARS, is making use of a monochrometer to determine the spectral response of certain insects.

The discussion would not be complete without mentioning nematode surveys. Much has been learned in the cooperative work conducted in relation to the golden nematode of potatoes. Survey for this pest is conducted by collecting and working of soil samples collected from potato fields, potato sheds and houses. The soybean cyst nematode survey has been conducted principally during the growing season to make use of crop condition observations combined with the collection of soil samples. Then we have the burrowing nematode, a free living nematode associated with citrus decline. Here samples of feeder roots of the host plant are collected and then processed in the laboratory. Survey for witchweed has been confined to visual inspection. The use of airplanes is also coming into use as a survey tool. The Forest Service for several years has used planes to check forest conditions. Helicopters are being used to locate isolated host plants in the Mediterranean fruit fly campaign. It is also planned to use aircraft in the forthcoming soybean cyst survey program.

In the foregoing discussion an attempt has been made to give enough information on the importance of early plant pest detection, on survey organizations, and survey techniques to cause us to ask ourselves what can be done to strengthen the detection program in our state or area. An organization which has as its only purpose the surveying for new pests might be the most desirable but at the present time can such an organization be financed? Pending the development of such a program might it not be possible with our existing personnel or with a limited number of additional workers to immeasurably strengthen the detection program now existing? Perhaps just a little added equipment or a little training would make possible a stronger detection program. One state in its light trap program conducted primarily to check on the armyworm, trained housewives to tend the traps and pick out specimens resembling the armyworm moth. These specimens were then sent to a specialist for identification. There are many possibilities that might be explored. We should caution, however,

in becoming over extended in any detection program developed. Too often more work is undertaken than can be properly handled. Light traps serve as a good example of this. Due to heavy catches in many instances the problem of preparing and identifying the catches becomes such a burden that it is impossible to satisfactorily continue the program, making workers and cooperators skeptical of any similar undertaking.

The Plant Pest Control Division is now organized so that its field personnel work on all Division programs within an assigned area. This certainly has its advantages in making it possible for each individual to observe more situations than when assigned to one specific problem. The Cooperative Economic Insect Report has recently started to issue statements on insects not known to be in the United States. These two illustrations are only given as examples of the emphasis being placed on detection of new pests on the Federal level. Some states are making it a definite assignment of their inspectors to widen their field of observation and make reports on those observations.

In closing it should again be emphasized that the best insect and plant disease detection program that can be developed is one in which all agricultural workers, whether they be Federal, State, industrial or private workers, take an active part. With such a program we should at least be able to find a new pest before it has become too serious a problem. The following from the 1956 Biennial Report of the Commissioner of Agriculture from a State with an active plant pest survey program might well be used as a final statement. "This survey has been an outstanding service to North Dakota Agriculture. Since its inception no critical insect infestations have developed without being detected at an early stage, thereby enabling systematic, economical and effective control. Without question, many thousands of dollars have been saved by our farmers."

STATE CLEARING OFFICES
for Economic Insect Survey Reports

Alabama	Dr. F. S. Arant, Head, Department of Zoology and Entomology, Alabama Polytechnic Institute, Auburn
Alaska	Dr. Richard H. Washburn, Entomologist, Agricultural Experiment Station, Palmer
Arizona	Dr. L. A. Carruth, Head, Department of Entomology, College of Agriculture, University of Arizona, Tucson
Arkansas	Mr. Gordon Barnes, Extension Entomologist, University of Arkansas, Fayetteville
California	Mr. R. W. Harper, Chief, Bureau of Entomology, State Department of Agriculture, Sacramento 14
Colorado	Dr. Leslie B. Daniels, Head, Department of Entomology, Colorado State University, Ft. Collins
Connecticut	Mr. J. Peter Johnson, Associate Entomologist, Agricultural Experiment Station, P. O. Box 1106, New Haven 4
Delaware	Dr. L. A. Stearns, Head, Department of Entomology, University of Delaware, Newark
Florida	Mr. Ed L. Ayers, Plant Commissioner, State Plant Board of Florida, Gainesville
Georgia	Dr. C. R. Jordan, Extension Entomologist, College of Agriculture, University of Georgia, Athens
Hawaii	Division of Entomology & Marketing, Board of Agriculture and Forestry, Honolulu 1
Idaho	Dr. H. C. Manis, Head, Department of Entomology, University of Idaho, Moscow
Illinois	Dr. H. B. Petty, Jr., Extension Entomologist, Illinois Agricultural Extension Service, 280 Natural Resources Building, Urbana
Indiana	Dr. John V. Osmun, Head, Department of Entomology, Purdue University, Lafayette
Iowa	Dr. H. M. Harris, Head, Department of Zoology and Entomology, Iowa State College, Ames
Kansas	Dr. Herbert Knutson, Head, Department of Entomology, Kansas State College, Manhattan

Kentucky	Mr. W. A. Price, Head, Department of Entomology, University of Kentucky, Lexington
Louisiana	Dr. L. D. Newsom, Head, Department of Entomology, Louisiana State University, Baton Rouge 3
Maine	Dr. G. W. Simpson, Head, Department of Entomology, University of Maine, Orono
Maryland	Department of Entomology, University of Maryland, College Park
Massachusetts	Department of Entomology, University of Massachusetts, Amherst
Michigan	Mr. Ray Hutson, Head, Department of Entomology, Michigan State University, East Lansing 13
Minnesota	Mr. T. L. Aamodt, Director, Plant Industry Division, 312 Coffey Hall, Department of Agriculture, Dairy and Food, University Farm, St. Paul 1
Mississippi	Dr. R. E. Hutchins, Head, Department of Entomology, and Zoology, Mississippi State College, State College
Missouri	Mr. Stirling Kyd, Extension Entomologist, Department of Entomology, University of Missouri, Columbia
Montana	Dr. J. H. Pepper, Head, Department of Zoology and Entomology, Montana State College, Bozeman
Nebraska	Dr. Roscoe E. Hill, Chairman, Department of Entomology, University of Nebraska, Lincoln 9
Nevada	Division of Plant Industry, Department of Agriculture, Reno
New Hampshire	Dr. J. G. Conklin, Professor of Economic Entomology, University of New Hampshire, Durham
New Jersey	Dr. B. B. Pepper, Chairman, Department of Entomology, Rutgers University, New Brunswick
New Mexico	Mr. John J. Durkin, Extension Entomologist, New Mexico College of A & M Arts, State College
New York	Department of Entomology and Plant Pathology, Cornell University, Ithaca
North Carolina	Mr. George D. Jones, Extension Entomologist, State College of Agriculture, Raleigh

North Dakota	Dr. J. A. Callenbach, Chairman, Department of Entomology, North Dakota State College, Fargo
Ohio	Dr. C. R. Neiswander, Associate Chairman, Department of Entomology, Ohio Agricultural Experiment Station, Wooster
Oklahoma	Dr. D. E. Howell, Head, Department of Entomology, Oklahoma State University, Stillwater, Okla.
Oregon	Mr. Joe Capizzi, Survey Entomologist, Division of Plant Industry, Oregon Department of Agriculture, Salem
Pennsylvania	Mr. J. O. Pepper, Extension Entomologist, Pennsylvania State University, University Park
Puerto Rico	Agricultural Experiment Station, Rio Piedras
Rhode Island	Dr. F. L. Howard, Head, Department of Plant Pathology and Entomology, University of Rhode Island, Kingston
South Carolina	Mr. W. C. Nettles, Leader, Extension Entomology and Plant Disease Work, Clemson Agricultural College, Clemson
South Dakota	Dr. G. B. Spawn, Head, Department of Zoology-Entomology, South Dakota State College of A & M Arts, College Station
Tennessee	Mr. R. P. Mullett, Extension Entomologist and Plant Pathologist, College of Agriculture, University of Tennessee, Knoxville 16
Texas	Dr. J. C. Gaines, Head, Department of Entomology, Texas A & M College, College Station
Utah	Dr. George F. Knowlton, Extension Entomologist, Utah State Agricultural College, Logan
Vermont	Mr. John Scott, Director, Division of Plant Pest Control, State Department of Agriculture, Montpelier
Virginia	Dr. J. O. Rowell, Extension Entomologist, Virginia Polytechnic Institute, Blacksburg
Washington	Dr. Horace S. Telford, Chairman, Department of Entomology, Washington State College, Pullman
West Virginia	Dr. C. K. Dorsey, Professor of Entomology, West Virginia University, Morgantown
Wisconsin	Mr. E. L. Chambers, Chief, Plant Industry Division, 315 North Carroll Street, Madison 3
Wyoming	Mr. Everett W. Spackman, State Entomologist, Division of Entomology and Plant Industry, Department of Agriculture, 308 Capitol Building, Cheyenne

LIST OF STATE KEY MEN
FOR THE COOPERATIVE CROP PROTECTION PROGRAM (PLANT DISEASES)

State or Territory	Leaders and Addresses
Alabama	Dr. J. A. Lyle, Dept. of Botany & Plant Pathology, Alabama Polytechnic Institute, Auburn, Alabama
Alaska	Dr. C. E. Logsdon, Alaska Agricultural Experiment Station, University of Alaska, Palmer, Alaska
Arizona	Dr. R. B. Streets, Dept. of Plant Pathology, University of Arizona, Tucson, Arizona
Arkansas	Dr. E. M. Cralley, Dept. of Plant Pathology, University of Arkansas, Fayetteville, Arkansas
California	Dr. Gilbert L. Stout, California State Dept. of Agriculture, Sacramento, California
Canada	Dr. J. H. Craigie, Div. of Botany & Plant Pathology, Dept. of Agriculture, Ottawa, Ontario
Colorado	Dr. J. L. Fults, Dept. of Botany & Plant Pathology, Colorado State University, Ft. Collins, Colo.
Connecticut	Dr. Paul E. Waggoner, Box 1106, New Haven 4, Connecticut
Delaware	Dr. John W. Heuberger, Dept. of Plant Pathology, University of Delaware, Newark, Delaware
Florida	Dr. Phares Decker, Dept. of Botany & Plant Pathology, Univ. of Florida, Gainesville, Fla.
Georgia	Dr. Julian H. Miller, Dept. of Plant Pathology, University of Georgia, Athens, Georgia
Hawaii	Dr. J. Walter Hendrix, Hawaii Agricultural Experiment Station, University of Hawaii, Honolulu 1, Hawaii
Idaho	Dr. A. M. Finley, Dept. of Plant Pathology, University of Idaho, Moscow, Idaho
Illinois	Dr. W. M. Bever, Dept. of Agronomy, Agricultural Experiment Station, Urbana, Illinois
Indiana	Dr. Ralph M. Caldwell, Dept. of Botany & Plant Pathology, Purdue University, Lafayette, Ind.
Iowa	Dr. W. F. Buchholtz, Botany & Plant Pathology, Dept., Iowa State College, Ames, Iowa
Kansas	Dr. S. M. Pady, Dept. of Botany & Plant Pathology, Kansas State College, Manhattan, Kansas

State or Territory	Leaders and Addresses
Kentucky	Dr. W. D. Valleau, Agronomy Dept., University of Kentucky, Lexington, Kentucky
Louisiana	Dr. S. P. Chilton, Dept. of Botany, Bacteriology & Plant Pathology, Louisiana State University, University Station, Baton Rouge 3, Louisiana
Maine	Dr. Donald Folsom, Plant Science Bldg., Univ. of Maine, Orono, Maine
Maryland	Dr. L. O. Weaver, University of Maryland, Dept. of Plant Pathology, College Park, Maryland
Massachusetts	Dr. C. J. Gilgut, Dept. of Botany, University of Massachusetts, Amherst, Massachusetts
Michigan	Dr. W. B. Drew, Dept. of Botany & Plant Pathology, Michigan State College, East Lansing, Michigan
Minnesota	Dr. J. J. Christensen, Dept. of Plant Pathology & Botany, Univ. of Minnesota, University Farm, St. Paul 1, Minnesota
Mississippi	Dr. R. E. Hutchins, Dept. of Zoology & Entomology, Mississippi State College, State College, Miss.
Missouri	Dr. T. W. Bretz, Dept. of Forestry, University of Missouri, Columbus, Missouri
Montana	Dr. H. E. Morris, Dept. of Botany & Bacteriology, Montana State College, Bozeman, Montana
Nebraska	Dr. M. G. Bossalis, Dept. of Plant Pathology, University of Nebraska, Lincoln, Nebraska
Nevada	Dr. Oliver Smith, University of Nevada, Reno, Nevada
New Hampshire	Dr. Avery Rich, Dept. of Botany & Plant Pathology, Univ. of New Hampshire, Durham, N. H.
New Jersey	Dr. C. M. Haenseler, Dept. of Plant Pathology, New Jersey State College, New Brunswick, N. J.
New Mexico	Dr. R. F. Crawford, Dept. of Biology, New Mexico College of Agriculture & Mechanic Arts, State College, New Mexico
New York	Dr. G. C. Kent, Dept. of Plant Pathology, Cornell University, Ithaca, New York
North Carolina	Dr. D. E. Ellis, Plant Pathology Section, North Carolina State College, Raleigh, North Carolina

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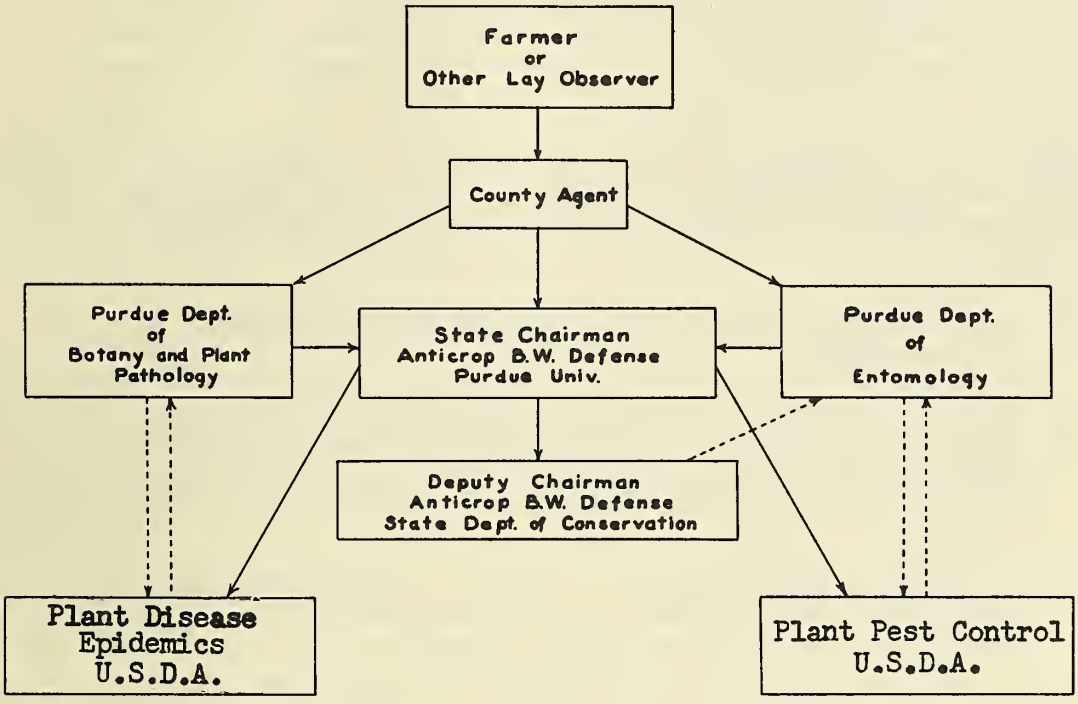
State or Territory	Leaders and Addresses
North Dakota	Dr. W. E. Brentzel, Dept. of Plant Pathology, North Dakota State College, Fargo, North Dakota
Ohio	Dr. Blair F. Janson, Agricultural Extension Service, Ohio State University, Columbus 10, Ohio
Oklahoma	Dr. W. W. Hansen, Dept. of Botany & Plant Pathology, Oklahoma State University, Stillwater, Okla.
Oregon	Dr. S. M. Dietz, Dept. of Botany & Plant Pathology, Oregon State College, Corvallis, Oregon
Pennsylvania	Dr. R. S. Kirby, Dept. of Botany, Pennsylvania State College, State College, Pennsylvania
Puerto Rico	Dr. L. A. Alvarez, Dept. of Plant Pathology, University of Puerto Rico, Rio Piedras, Puerto Rico
Rhode Island	Dr. Frank L. Howard, Dept. of Plant Pathology & Entomology, University of Rhode Island, Kingston, Rhode Island
South Carolina	Dr. W. M. Epps, Botany & Bacteriology Dept., Clemson Agricultural College, Clemson, South Carolina
South Dakota	Dr. C. M. Nagel, Dept. of Plant Pathology, South Dakota State College, Brookings, South Dakota
Tennessee	Dr. J. O. Andes, Dept. of Plant Pathology, University of Tennessee, Knoxville, Tennessee
Texas	Dr. G. M. Watkins, Dept. of Plant Physiology & Plant Pathology, Agric. Exp. Station, College Station, Texas
Utah	Dr. R. W. Ames, Dept. of Botany & Plant Pathology, Utah State Agricultural College, Logan, Utah
Vermont	Dr. Thomas Sproston, Jr., Dept. of Botany & Plant Pathology, University of Vermont, Burlington, Vermont
Virginia	Dr. S. B. Fenne, Biology Department, Virginia Polytechnic Institute, Blacksburg, Virginia
Washington	Dr. George W. Fischer, Dept. of Plant Pathology, State College of Washington, Pullman, Washington
West Virginia	Dr. J. G. Leach, Dept. of Plant Pathology & Bacteriology, University of West Virginia, Morgantown, West Virginia
Wisconsin	Dr. G. S. Pound, Dept. of Plant Pathology, University of Wisconsin, Madison, Wisconsin
Wyoming	Dr. H. T. Northern, Dept. of Agronomy & Economics, University of Wyoming, Laramie, Wyoming

INDIANA DEPARTMENT OF CIVIL DEFENSE
BIOLOGICAL WARFARE SECTION

Defense against Anticrop B.W.

Lines of Communication to be Followed in Case of a Suspected B.W. Incident



THE ROLE OF THE USDA IN CROPS REGULATORY PROGRAMS

W. L. Popham, Assistant Administrator
Agricultural Research Service
U. S. Department of Agriculture

To describe in a few words the role of the United States Department of Agriculture in crops regulatory programs is not a simple task. All such work is cooperative to some degree -- objectives vary; property rights must be respected; the division of responsibility between various segments of Government and individual property owners is an important consideration; in fact, the location and nature of the problem, and the potential of the particular pest as a crop destroyer often dictates where and by whom certain functions can best be performed.

The authority granted to the Department to cooperate with States in crops regulatory and control work is contained in seven different pieces of legislation: The Plant Pest Act of 1905, the Plant Quarantine Act of 1912, Mexican Border Act, the Emergency Outbreak Act of 1938, the Nematode Act, the Organic Act of 1944, and the Mollusk Act. In each of these the Secretary of Agriculture is given broad authority to carry out such measures as may be necessary to fulfill the intent of the legislation.

As a basis for our discussion I will try to point up where in my opinion the Department can best serve the public in this broad and complex field. It seems to me that the Department has responsibility in varying degrees in connection with:

(a) Port-of-entry inspection to prevent the introduction of foreign pests,

(b) Surveys to detect, in the incipient stage, an infestation of a pest which has penetrated the first line of defense and become established in a limited area in this country,

(c) Cooperative eradication or control programs involving pests that are confined to a limited area in this country and threaten to spread throughout their ecological range unless suppressive measures are taken,

(d) Research in support of regulatory and control programs, and

(e) To join with States, local agencies, and individuals in financing such work.

Both the objective and the degree of responsibility associated with port-of-entry inspection are quite clear. Under existing legislation the Federal government has the legal responsibility to take such steps as may be necessary to prevent the entry into this country of foreign pests that might prove detrimental to our agricultural economy. In our efforts to fulfill this obligation we are constantly reviewing, expanding, and strengthening our inspection work at ports, airfields, and border inspection stations. The Plant Quarantine Division of the Agricultural Research Service is directly responsible for this work. Over the years a vast reservoir of knowledge has been accumulated regarding foreign pests and the means by which they are carried from one area to another. The Division cooperates with foreign governments in making surveys to record the occurrence and distribution of pests that represent a threat to American agriculture. An intensive educational program is under way to acquaint the traveling public with the risk associated with the introduction of unauthorized plants and plant products. Procedures have been worked out for inspection at point of origin, particularly where mass military movement from foreign bases is involved.

In assuming responsibility for port-of-entry inspection, the Agricultural Research Service, of course, is glad to receive assistance from the States, local port authorities, and those who are engaged in international trade.

In providing for a nation-wide survey in support of the first line of defense carries us into the area of direct Federal-State relations and Federal-State cooperation. We like to think of survey as a joint undertaking in which all entomologists and pathologists participate -- a jointly planned and financed program strongly supported by the voluntary efforts, not only of scientists but of individual farmers, agricultural advisers, and crop observers country-wide. Our recent experiences with such pests as the corn borer, Japanese beetle, white-fringed beetle, Mediterranean fruit fly, and khapra beetle point up the urgency of a survey adequate to detect promptly incipient infestations of a foreign invader. A matter of only a few weeks' delay in reporting such an infestation may mean the difference between success and failure in an eradication effort; or it may mean saving millions of dollars to the taxpayer in eradication or control costs. An adequate nation-wide survey is a tremendous undertaking. It cannot be developed in a season or two. We have only scratched the surface in our exploiting of opportunities in this direction.

When a destructive plant pest, nematode, virus, or plant parasite becomes established in a limited area in this country and threatens to spread throughout the range of the host crops it attacks, we are confronted with a joint responsibility that leads us into that "grey" area of Federal-State responsibility and relations so difficult to define. There is a lot of difference between joining with the State of Florida, which grows 70 percent of the citrus produced in the United States, in the eradication of the Mediterranean fruit fly -- and to join with New Jersey in the

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eradication or suppression of an insect or a disease of little concern locally, but one which is capable of causing widespread commercial damage should it reach major corn, cotton, or fruit-growing areas of the country.

To bring more clearly into focus Federal-State responsibility in dealing with problems of this kind, the Executive Committee of the National Association of Commissioners, Secretaries and Directors of Agriculture, at the invitation of Secretary Benson, made a thorough study of cooperative plant pest control programs currently in operation, and with this background developed a policy statement which has become a basic reference in planning cooperative work. Most of you have had an opportunity to review this policy statement. If you haven't, I am sure that you can obtain a copy from either the State entomologist in your State, or from your area or regional supervisor.

In reporting its findings, the Executive Committee made clear that the objective of a program is an important consideration in determining the extent of responsibility resting with the Federal government. If an incipient infestation of a destructive pest can be eradicated, the Federal government should be prepared to take such action as may be necessary to achieve that goal as a protection to uninfested portions of the country. This, of course, contemplates full cooperation on the part of States in the way of State authority, technical assistance, and financial support. The principle of joint planning and cost-sharing is clearly set forth; likewise the responsibility that rests with the Federal government to develop, from world-wide sources, background information that may be useful in an eradication effort is clearly defined. The states might well look to the Federal government as a source of background information, trained personnel, specialized equipment, and a reservoir of funds that are needed to act promptly in such situations.

No two problems are alike. We believe strongly in the principle of cost-sharing. We like to see State participation on about a 50-50 basis in the over-all. To avoid costly delays this should be a matter of negotiation in the initial stages of a program, taking into account the nature of the problem, the extent of State interest, and the ability of individual States to participate rather than to make it a legislative matter.

The need for research in support of regulatory and control programs cannot be over-emphasized. Without the knowledge gained by research on fruit flies in Hawaii the eradication of the Mediterranean fruit fly in Florida would have been a long, expensive and arduous task -- if not an impossibility. Unlike the 1929 infestation, the Medfly this time invaded the metropolitan areas of Miami, Palm Beach, Fort Lauderdale, Fort Myers, St. Petersburg -- areas in which both native and ornamental hosts are abundant. Out of Hawaii came a highly effective lure for traps, an attractant to be combined with a toxic chemical in our sprays, a detailed knowledge of the biology of the Medfly, and when need arose, a synthetic substitute for the lure used in the trapping program -- the latter a

development of the Pesticide Chemicals Research Section of the Entomology Research Division at Beltsville.

Looking to the future we who are engaged in the application of research findings in dealing with insects, plant diseases, nematodes, etc., have a continuing interest in the opportunities that seem to exist for improving our trapping procedures, developing attractants that may be added to toxic materials in formulating sprays, thus achieving more complete control with less chemical and at reduced cost. We would like to see more work done on pests that have not yet reached the United States. We would like to feel the security that comes with having people experienced in research techniques available to undertake, on a moment's notice, the operational type of investigations that must go hand in hand with any regulatory or control programs.

Any formula that is used for distributing the cost of pest eradication and control work needs to be flexible. Each situation must be dealt with more or less on its own merits -- particularly in the beginning when the extent of the problem is unknown. The species involved, and the location and extent of an infestation will often govern how much responsibility can properly be borne by the individual whose property is involved, and, in turn, the various segments of government.

DEVELOPING AN ACTION PROGRAM

E. D. Burgess, Director,
Plant Pest Control Division
Agricultural Research Service
U. S. Department of Agriculture
Washington, D. C.

We have been talking about various aspects of crops regulatory programs with somewhat of a view to what might be done to protect the agriculture of the country in time of an emergency. As my contribution to these discussions, I would like -- with the help of various Plant Board people and our own Division personnel -- to point out some of the considerations that go into the development of an action program. While my remarks were not written as a plea for the cooperation of those not directly associated with the regulatory functions of the states and the Federal government, they do, I think, point out our great need for the active interest of scientists in associated fields.

When a pest of foreign origin is first found in the United States, a number of state and Federal agencies are quickly faced with the necessity of reaching a prompt decision as to the best way of handling a new and usually unique problem. The subsequent action taken may have a far reaching effect upon a great many people and possibly on the economy of a local area, a state, a region or perhaps the entire country. It is of the utmost importance, therefore, that the planning from the beginning be based upon the soundest biological factors available, even though background information at the time may leave something to be desired. In many cases there is not sufficient knowledge of the biology, control, or the potential ecological range in this country for use as guides in developing a program. As an example, we currently find ourselves considering two new problems, that pertaining to "witchweed", a potentially serious parasitic plant attacking corn, and the soybean cyst nematode. In neither case is there as much information as we would like to have available to plan a course of action. It is important, therefore, that as much background as possible be marshalled at the outset -- from any source whatever.

The initial study of a new problem should take into consideration several important factors. Here are just a few of the thoughts that run through the minds of regulatory folks in their early considerations. Is the invader, in fact, a serious agricultural pest, which, if allowed to spread would become an important deterrent in the production or subsequent handling of the commodity it attacks? If so, are methods available which can be translated into an eradication, control, or prevention of spread program? What do we know about detection at low population densities? What are the means of spread from place to place, particularly those that would disseminate it over long distances? What can be done to cut off or interrupt these avenues with the least disruption of the orderly movement of the commodities involved?

For the sake of this discussion we will confine ourselves to those pests where there is ample reason to believe that something of an organized control or regulatory nature should be undertaken. This decision in itself is not always simple. It is often dependent on the multiple judgment of state and Federal research and regulatory agencies that the pest in question is capable of inflicting severe crop damage under conditions existing in this country. It often happens that the insect or disease has been recognized as a destructive pest elsewhere in the world. This, of course, simplifies the determination. On the other hand, the record might indicate that in its native habitat it had been of little or no economic importance, possibly due to suppression by native parasites, predators or other factors. In other cases, long association with it in its homeland may have resulted in a general public acceptance of a rather high loss. In many tropical or semitropical areas where fruit flies are prevalent, wormy fruit may be taken as a matter of course. However, there would seem to be no disagreement that in this country the American housewife would refuse to purchase and utilize wormy fruits or vegetables.

What, then, should be done? Naturally, our first thought is that of elimination before a new pest gets a good foothold. Let me cite you a few examples of this approach. In the case of the Medfly we were blessed with insecticides and survey methods that gave us better than a 50-50 chance of gaining that objective, even though it couldn't be attacked in the same manner as in the 1929-30 campaign. In 1956 it was found first in the Miami area of Florida where it involved fruits of the Surinam cherry and other wild and cultivated hosts. Surinam cherry is a popular ornamental plant in subtropical metropolitan areas and is often planted in hedges. In the towns and cities of southern Florida it can be found almost everywhere you look. It is a prolific plant, producing a succession of fruits -- an ecological heaven for the Medfly. With the involvement of this host, and some others, it was soon realized that it would be a physical impossibility to pick and destroy fruit to establish a host-free or starvation period as was done in central Florida in 1929-30. Fortunately, research through the years in Hawaii had developed an effective bait spray. So, although the on-the-ground appraisal of the situation quickly indicated that the 1929-30 procedures would not be a good bet in the 1956 situation, it was possible to undertake an immediate eradication program, placing dependence on recent research information to accomplish this objective.

A few years ago it would have been almost out of the question to undertake the eradication of the khapra beetle. It is an insect extremely difficult, if not impossible, to kill by traditional means. However, the initiative and creative genius of workers in the west, who envisioned and tried wrap-up fumigations of entire grain or feed establishments, using huge tarps, brought such a possibility to life. All other normal eradication procedures had to be rejected as being either biologically inadequate or impractical of being carried out under the existing conditions. I mention this to point out that even though methods may not be

available at the outset of a program, the ingenuity of intensely interested scientists will find ways of coping with a situation which on the face of it appears impossible.

We have briefly discussed two current eradication programs. Each of them was undertaken before infestations became general over large areas. Each of them, however, illustrates the need for prompt research information -- not necessarily the kind that growers can use immediately but that which will permit public agencies to undertake aggressive corrective action even if initial costs appear to make it prohibitive.

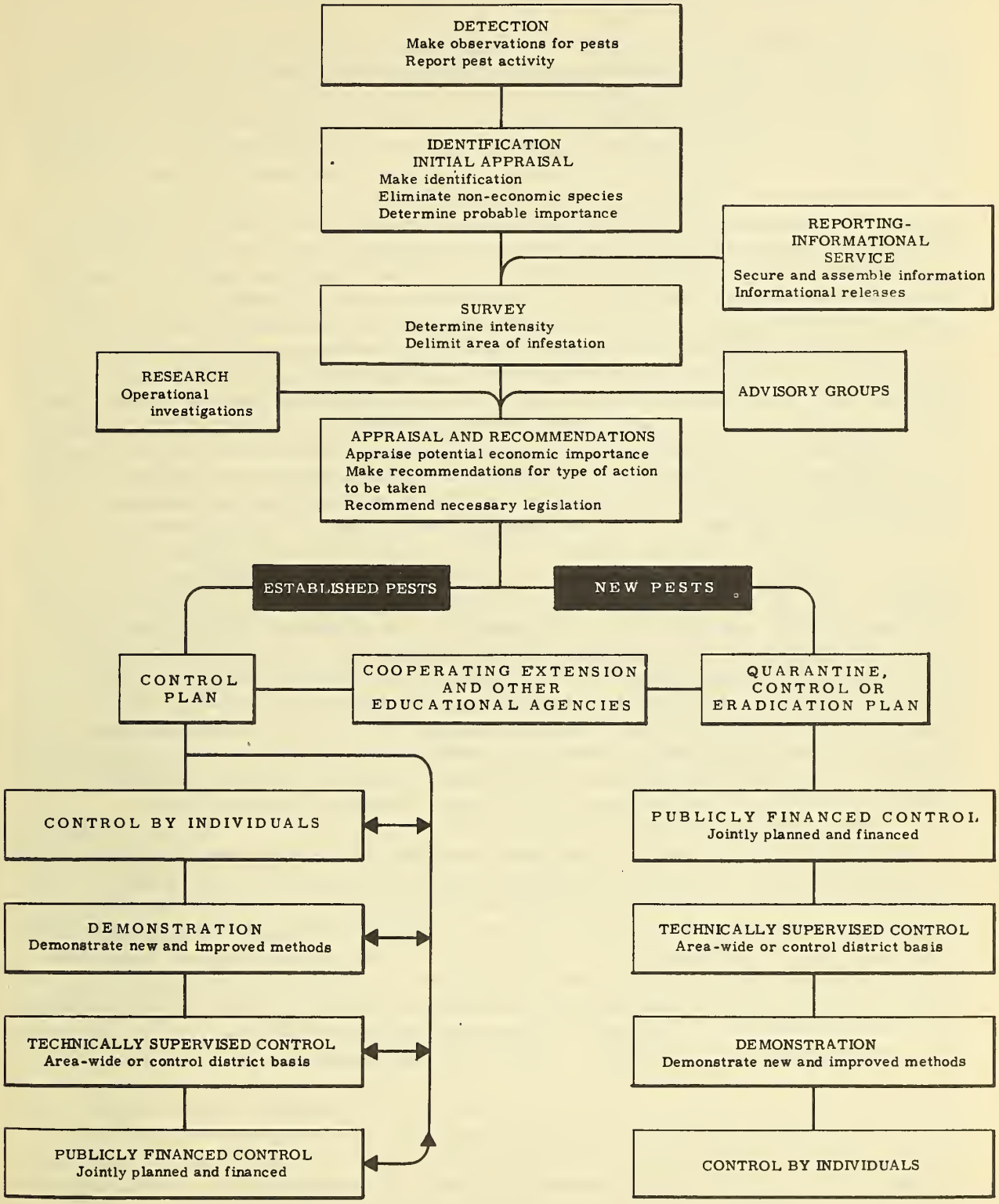
It might be of interest to give some consideration to the recently inaugurated eradication program against the gypsy moth, an insect pest which has been present in this country for about three-quarters of a century. One might well ask, "Why wasn't this pest eradicated promptly when it first became known?" The answer to that question is that efforts were made to eradicate it but adequate measures to insure success were not then available and public interest lagged at a time when it might have been accomplished even under those early conditions. Only since the development of DDT has a tool become available which is recognized as being sufficiently effective to warrant initiating an eradication program over the 40 million acres in which it exists. You might further ask, "Have these many years of fighting a containment battle been worth it?" We feel that it has. It still occurs within a relatively small area compared to its potential range in the United States. Prevention of spread through the years has thus saved individuals, communities, or states, as the case may be, large amounts of money that otherwise would be needed for control in the south and midwest where it does not occur. Now we can progressively rid the country of it, and permit further savings in the northeastern states which have become accustomed to spending about $2 million a year to cope with it.

In other programs, such as the white-fringed beetle which has been with us for over 20 years, we are standing at the crossroads. Lack of earlier knowledge prevented an immediate eradication program and permitted one adequate only to retard its spread. Now, control and research people are reaching agreement that chemicals and methods of application are available which, if properly used, may bring about complete eradication of any known infestation. Several states have already indicated a desire to cooperate in a full-scale program of elimination.

Obviously, striking out on an eradication effort is more often than not the exception rather than the rule, and something short of this must be undertaken. Several years ago, the Bureau of Entomology and Plant Quarantine prepared a chart (Figure 1) outlining the interrelationship between the numerous activities and groups associated with the broad field of pest control. The chart graphically presents the course of action normally taken leading towards a control program. It points up, again, the place of prompt, aggressive action to eradicate and prevent the spread of plant pests new to this country. Whatever the objective, incipient infestations of serious agricultural pests must be confined to the limited area in which they are found. Again, the situation is usually complicated by the lack of sufficient information concerning means of

COOPERATIVE FEDERAL STATE PEST SERVICE*

Plant Pest Control Division



*Local, State, Federal, Industrial and Private Workers and Agencies

Prepared by PQ, 10/2/52
Revised by PPC, 10/15/56

spread and ways of decontaminating commodities or things capable of carrying them from place to place. Yet action must be taken promptly if further spread is to be prevented. This, of course, involves quarantines and the enforcement of the regulations thereto.

Authority to quarantine is derived from appropriate Federal and state laws. Federal plant quarantines are authorized by the Plant Quarantine Act of 1912. The Plant Quarantine Act authorizes the Secretary of Agriculture to quarantine any state, territory or district of the United States or any portion thereof, when he determines that such is necessary to prevent the spread of a dangerous plant disease or insect pest, new to or not heretofore widely distributed within and throughout the United States. Before taking such action that Act requires a public hearing at which any interested party is invited to express his views and submit information with regard to the proposed quarantine. Any state is legally within its rights to take such action as it deems necessary for its own protection until the Secretary has established a quarantine with respect to it. We have just recently held hearings on a new parasitic plant disease of corn, "witchweed", and on the soybean cyst nematode. Research advisors tell us that witchweed, were it to become widespread, might put the European corn borer to shame. A native of South Africa, it is known to be present in the United States in 8 counties, four each in the states of North and South Carolina. The soybean cyst nematode, as you know, has been recently found in the Mississippi delta regions of Tennessee and Missouri in addition to its previously known home in North Carolina.

Federal domestic plant quarantines relating to pests within the continental United States are now in effect with respect to a number of them, such as the stem rust of wheat, gypsy moth, Japanese beetle, pink bollworm, Mexican fruit fly, white-fringed beetle, khapra beetle, European chafer and the Mediterranean fruit fly. In addition, the Plant Pest Control Division is cooperating with the states in enforcement of a number of state quarantines. Among them are those pertaining to the sweetpotato weevil, phony peach and peach mosaic diseases, and golden nematode of potato. Likewise, state plant regulatory authorities cooperate actively in enforcement of Federal domestic quarantines.

A Federal quarantine and its related documents set forth certain facts. It names the pest concerned and the states to be quarantined. The commodities affected by the action are described so that no misunderstanding will occur among shippers and others. The conditions governing movement and the procedure and conditions of certification are likewise essential parts of a quarantine. In recent years provisions have been made for the Division to outline in administrative instructions the areas to be regulated and to exempt from certification certain articles when there is little or no hazard in their free movement.

Certificates and permits are the passports of quarantine enforcement. They are issued by inspectors when inspection of the product fails to reveal infestation, when it has been handled in such a way as to preclude infestation, or it is to be moved to a safe destination for processing or immediate consumption, or the product has been so treated as to destroy

infestation. Each certificate or permit is evidence to carriers, transit and terminal inspectors that the commodity is moving in compliance with the quarantine. A simple, small, sticker certificate identifies individual shipments. A master certificate attached to the waybill may clear the way for a truck or freight carload. The rubber stamp certificate for individual containers is replacing the package certificate to some extent. A limited permit is designed to allow movement of regulated articles to specific destinations when it is considered safe to do so. For example, there seems to be little hazard in allowing certain host fruits of the Mediterranean fruit fly to move to northern markets for consumption when diversion of such shipments is prohibited.

When a quarantine is issued there are many pressures on regulatory authorities to do everything possible to provide for safe movement of regulated products in normal trade channels with the least possible disruption of the industry involved. We, of course, are anxious that as little inconvenience as possible is experienced by those finding themselves under quarantine restrictions. We must also bear in mind, however, that a Federal or state certificate is the "hallmark" of the commodity indicating to receiving states that there is better than reasonable assurance that the commodity is free from living pests in question. Lack of confidence in certificates would lead to disastrous results. To find the means for safe movement is of extreme urgency to prevent avoidable losses to the industry concerned. Fumigants, insecticides, heat or cold treatments, sanitary methods of processing and other devices are among the tools of the trade in disinfesting commodities of one kind or another.

As an adjunct to the enforcement of quarantine regulations, we have long since come to the conclusion that an important factor in an effective prevention of spread program is linked with the suppression of high populations. Control programs may, therefore, go hand in hand with regulatory operations since the hazard of spread is greatly reduced when populations are low or nonexistent in areas from which commodities are moving that may carry a pest from one place to another.

We have up to now recited some of the considerations that go into the making of a program and talked a little bit about quarantines. Lest there be the feeling that this is the complete story, let me say a few words about some of the additional obstacles which demand attention and usually require immediate action.

When a control, regulatory, or eradication program is undertaken, particularly if toxic chemicals are to be used, other public and private agencies become involved almost immediately. Federal, state and local health officials, for example, are invariably interested in the effect of the proposed program on the health of the people living where the chemicals are to be used.

The question of pesticide residues on food or feed crops brings the food and drug authorities into the picture. There are few chemicals toxic to plant pests that are not poisonous to warm blooded animals to one degree or another. If residue data are not available we are faced with the problem of determining if the proposed rates of application will result in dangerous residues. Fortunately, in most instances, the rate of application -- as for example, malathion spray for Medfly -- has not resulted in residues considered harmful to the public health and to wildlife. However, there have been times when very effective chemicals could not be used until the required residue studies were made to establish the true situation. This points up the value and the necessity of appropriate residue studies being conducted at the same time the chemicals are being tested.

The Fish and Wildlife Service is intensely interested in protecting animals and game that may be all too scarce in some parts of the country. State and local sportsmen's associations must be assured that their interests are being protected. State and Federal control organizations work with them constantly in the development of area-wide control or eradication programs, and their cooperation is usually forthcoming when it is understood that prompt eradication of a pest is often preferable from the standpoint of long-range conservation than if the pest were to become generally established and farmers and others must resort to a wide use of additional poisonous chemicals for control.

The use of aircraft in the application of pesticides involves the operations of the Civil Aeronautics Administration and other aeronautical authorities. Aircraft operators must receive the appropriate inspections and secure authorization from Federal, state, and local officials to operate. When metropolitan or congested areas are involved the requirements to be met may differ substantially from those if the plane is to be operated over farmland or forests only.

There are the beekeepers, the question of phytotoxicity of treated plants, and a thousand and one other considerations that come to light as each new program comes into being.

The necessity for cooperation with and clearance by these various agencies and organizations may, if overlooked, complicate the inauguration of a program. The value of public relations work leading to a general awareness of the problem and the sacrifices they may be called upon to make cannot be underestimated. All of us associated with crops regulatory programs are attuned to these needs when action programs for the protection of the greatest number are to be undertaken. There must be the full cooperation with the press, extension people, and those in research in bringing a regulatory program into being. It is essential in the successful conduct of such an activity. In closing let me say that we sincerely hope the meetings have brought into focus the avenues along which we can travel more closely together in order to solve crops regulatory programs which now or in time of a national emergency might face the agricultural economy of the United States.

PUBLIC RELATIONS NECESSARY IN PEST CONTROL

M. P. Jones, Extension Entomologist
Federal Extension Service
U. S. Department of Agriculture

The success of any new- or large-scale program will depend to a great extent on the degree to which the public understands the program. It behooves each of us, therefore, to bring the public up-to-date on all matters relating to pest control and quarantines.

How do we do this? Well, there are many avenues and many ways for doing the job, and the people most directly affected are not the only ones to be reached. For instance, when a crop insect invades an agricultural area, the farmers growing that particular crop in the immediate area are naturally the first to be alarmed. But is the problem all theirs? Who besides this group needs to be appraised of the presence of a potential pest? Farmers the country over need to be informed that the pest may some day attack their crop if it is not eradicated or prevented from spreading. Urban residents need also to know about the pest and be informed of the way they may be affected. People in all walks of life are taxpayers and as money for carrying on research, quarantine and control, or eradication projects comes from public funds, all must be properly informed, so that they will lend their support wherever possible.

The problem then is to bridge the span between the pool of available knowledge and the people concerned.

To do this properly, pertinent facts must be extracted from the pool of knowledge and related to the needs and aims of people. Facts by themselves are homeless waifs unless organized, applied, and interpreted. For greater effectiveness, this joining of knowledge with needs should be a mutual endeavor between people concerned and professional leaders.

When this is done, factual knowledge becomes an organized endeavor or program which has a beneficial message.

The objective then becomes one of bridging the gap between the organized factual message and the minds of people who are to be helped by it. A stout communication bridge makes it possible for the information to pass with ease and success, and it requires--

1. Reliable factual information.

2. Interpretation of the information in terms of the audience's needs, background, experience, educational level, attainable ambitions, and obstacles in the way to attainment.

3. Delivery of the message to the public in ways to insure its effectiveness, and presented by the closest authoritative source, preferably someone they know and in whom they have confidence.

What facilities or agencies are available for helping to bridge the gap? There are many who have a part in pest control. To mention only a few, we might include State and Federal regulatory officials, trained specialists in industry, research workers in the Federal Government, in State colleges, and experiment stations.

One arm of this U. S. Department of Agriculture and the State college is the Agricultural Extension Service. This is the largest adult educational organization in existence. More than 14,000 professionally trained men and women in all phases of agriculture and home economics make up the field force of the Extension Service. Approximately 11,000 of these are located in over 3,000 counties as men and women county extension agents. They vary in number from 1 to 17 per county. Over 3,000 technical workers are in the State offices and about 100 are in the Federal office. About 83 men in the State Extension offices are well-trained entomologists.

Local people are intensely interested in the Extension Service. Primarily, because they are a part of it. About 24 percent of the 113½ million dollars available to the Extension Service in 1956 came from within the counties, 33 percent from State and 43 percent from Federal sources. Expenditures, however, are different. About 68 percent is used in the counties, 31 percent in the State offices, and less than 2 percent in the Federal office.

Much strength of Extension's educational program is in the work of about a million voluntary men and women, who serve as local leaders. This group of loyal citizens support Extension's program by participating in surveys, conducting demonstrations, serving on committees, relaying information, keeping records, and in helping to organize local discussion and work groups. The Extension Service also supervises 4-H Club work, which is participated in by about 2½ million rural and urban youth. More than 32,000 of these are enrolled in entomology projects, according to the 1955 report, which is our last summary. This same report revealed that in 7½ million instances farmers and others were assisted in insect control practices by extension workers. Our efforts in pest control could be extended enormously if we would make full use of the 4-H Club members who in a surprisingly short time become the men and women of tomorrow.

Now that we have a better picture of some of the facilities in the Extension Service, let us view the problem from another angle. Louisiana made a critical analysis of the Annual Reports of the County Agents, and found that of the total number of farmers assisted, 40 percent of them

were assisted on problems relating to livestock pest control and 32 percent to problems relating to crop insect control.

A survey was made of the activities of Utah county agricultural agents. The tabulation from this study showed that 18,142 units or 40 percent of the agents' time related to insects and 7,348 units or 17 percent to rodent control, making a total of 57 percent of agents' time devoted to a field usually handled by the extension entomologists. In this Utah study, the county agents' activities were listed in 14 categories, as--agronomy, insect control, irrigation, marketing, and farm planning. The next closest rival to insect control was weed control with 9,262 units, or 21 percent of the agents' time. Thus 78 percent of the Utah county agents' time was spent on pest control.

An Arkansas county agent in developing program projection information made a list of a number of problem areas. This was sent to the farmers in his county who were invited to make additions when they received his list. They were also asked to rate the problem area in order of their importance to their farm operations. When the farmers' replies were analyzed under a point system, insect control came out with 1,934 points, its next closest rival 1,420 was on drainage; this was followed by fertilization with 1,415 points. The remainder of the 19,890 points was divided between 27 problem areas.

These three surveys show the importance of insect control to county agents' work. What training does the agent have to meet these needs? A survey to answer this question was made in one of the States. In all probability, their findings are quite typical of the country as a whole. Of the 148 agents that replied--

46 agents - 31 percent - had no courses in entomology

94 " - 64 " - had one course in entomology

8 " - 5 " - had more than one course in entomology

To teach the 11,000 county agents who have had so little training in entomology, the State Extension Services employ 83 entomologists to instruct the agents after they are in the counties. This number represents 4 percent of the total State specialists staff. Only 56 of the 83 spend full-time on general entomology. Seven devote full-time to beekeeping, and 20 divide their time between research, teaching, and extension, or between entomology and plant pathology, or full-time or part-time on the cooperative survey or wildlife management. The Federal Extension Office employs one entomologist, which is slightly less than two percent of its specialists staff.

While the Extension Service is the largest single agency dealing with adult education and public relations, it should be reemphasized that it is not the only one servicing the American public. There are possibly 1,500 technical people trained in pest control, working for Federal and State governments in the fields of survey, regulation, and control. These groups are constantly involved in public relations though they may not always realize it. It is also true with field service and technical development personnel with industry and with the Pest Control Operators.

Extension work like most educational programs results in voluntary action by the public. It has no regulatory authority or means for paying for participation in its programs. Extension's organization and the facilities at its disposal does much to help present a favorable climate, especially on matters pertaining to agriculture and home economics. Its effects are much more far-reaching than these fields, however. An increasing number of urban residents are aware of, and are using the Extension Service. This urban interest results in part from their becoming aware of the services we have to offer through mass educational media. County agents in the Extension Service are the key people for uncovering introduced pests. For example--

1. The recent Mediterranean fruit fly introduction into Florida was discovered by a resident of Miami, who took a larva he found in his homegrown grapefruit to his local newspaper and then to his county agent. To confirm his suspicion, the agent took the specimen to an entomologist, who in turn had it verified by a specialist on flies.

2. A Long Island, N. Y. farmer, whose potatoes failed to grow normally, sought the help of his county agent. Not having an answer to the problem, the agent called upon the plant pathologist, then on one specialist after another until it was discovered that a nematode was causing the trouble. The pest was later given the name--Golden Nematode.

3. In 1951, a South Carolina farmer went to his county agent about his sick corn. The agent took samples to the Pee Dee Experiment Station. The specialists attempted to tie the trouble to nematode, because of nematode damage to other crops.

4. In 1952, a North Carolina agent's attention was called to sick corn. This agent sent samples to the pest control clinic being held at State College. As the trouble could not be diagnosed the first year, specimens were sent in each year until 1956 when a foreign student suggested that a weed might be causing the damage. His suspicion was confirmed when the witchweed was found in the cornfield. This provided an answer for the sick corn in South Carolina.

5. Another North Carolina farmer came to his county agent for help with unthrifty spots in his soybean field. This agent turned to the specialist who later diagnosed the trouble as soybean cyst nematode.

6. The spotted alfalfa aphid in New Mexico, the Khapra beetle in California and Arizona, the walnut husk fly in California and the pear psyllid in Washington were discovered by farmers bringing their troubles to county agents.

With but little additional effort, many other instances would be revealed where county agents were the first Federal or State officials to have brought to their attention troubles which turned out to be introduced pests.

The agents are more than spotters of troubles. They follow thru with educational programs to familiarize farmers and others with the hazards associated with the pest. They give suggestions on control and help organize interested groups to facilitate eradicating or controlling it.

The pattern of education for many pests would be much the same. To illustrate one way the Extension supports a regulatory and control program, the Medfly situation is cited.

State extension specialists, State and Federal regulatory and control officials met with county agents in sub-district conferences. The agents were informed of the biology and habits of the insects, as well as the plans for carrying out the large-scale control operations. They were also assisted in the preparation of educational material. Through the press, radio, and TV, the total population of Florida was kept informed of quarantine actions and the reasons for them and the progress being made in control operations. In their meetings and other contacts with the public, the agents in cooperation with other officials continued to explain to the public the ways in which individuals could contribute to the Medfly eradication program, keeping them ever aware of the need for complete eradication. By keeping the public correctly informed, there was less opportunity for misinformation to get started that would interfere with the progress or success of the program.

In Collier County, Florida, there is a tomato growing area that would have suffered materially if a Medfly quarantine had been invoked. In an effort to rid the area of Medfly ninety days before harvest, the county agent held meetings, and organized growers and packers, which resulted in an intensive and successful cleanup program. All hosts of the Medfly were destroyed during the three months' period before tomato harvest. As no more Medflies were found during that period, regulatory officials removed the quarantine.

In the fruit fly control projects, all agencies concerned kept the traveling public alerted to the danger of spreading the pests by transporting susceptible hosts and discouraging them from promiscuous

carrying of host fruits out of the infested areas. They were encouraged also to report any suspected insect specimens or infested fruits to the proper authorities. In the infested area, information was given on proper disposal of dropped or overripe fruit, and they were advised on the proper insecticides to use in spraying.

We have discussed the work of the county agents. What about the State staff? The first responsibility of the extension entomologist in each State is to service the county extension agents. This short paper will not permit enumerating all of their activities, but practically all of them issue weekly news letters or timely service letters. These letters carry information on the presence or abundance of economic insects and announce the finding and distribution of new ones. Such letters also give recommendations for control of the insect pests. The information in such letters is derived from field observation by the extension entomologist, from special survey men, from research workers, from State and Federal regulatory officials and from any other authoritative source. When a situation warrants the specialist may issue special letters, make special trips to the counties, or by telephone give assistance to the agents. The specialists in the State Extension offices appear on TV, radio, and provide news release material for the daily and weekly newspapers, conducting method and result demonstrations. The results of method demonstrations are picked up and used by the agents, local leaders, and others. Result demonstrations serve as silent salesmen. They show the advantage to be gained from using recommended insect control measures, and help farmers decide which of several insecticides may best meet their needs.

Training schools are being held in a number of States to help agents and farmers to recognize more of the common insect pests. By knowing those that are common, the public would more quickly detect a strange one in their midst. Technical workers in Federal office through their administrators keep State Extension and Experiment Station directors informed on Federal actions relating to pest control and quarantines. Likewise entomologists in the Federal Government service their State counterparts with information, of regional, national, and international consequence. The extension entomologist with the Federal Extension Service serves in a liaison capacity between many Federal agencies and State Extension entomologists as well as between those in the States.

To carry its message to the public, the Extension Service uses every kind of informational media at its command. These include press, radio, TV, circular and special letters, public meetings, leader training schools, demonstrations, farm and home visits as well as office and phone calls. Supplemental visual material, such as motion pictures, slides and exhibits were used.

Thus it can be seen that the Extension Service has an organization as well as facilities for use in any program for the quarantine or control of any

introduced pest. Its nationwide organization reaches all counties and communities. Extension workers have training and experience for reaching the public with various kinds of subject matter, methods, and techniques. It has participated and done a creditable job in many emergencies in the past. Floods, droughts, freezes, fires besides pest control are examples.

The Extension Service can start its educational program immediately on the finding of a new pest. Regulatory, quarantine, and control operations can follow as soon as they can be promulgated.

Some points to be stressed in keeping the public properly informed on pest control and quarantine are to:

1. Make known the fact that most of our major plant pests are of foreign origin.

2. Inform the public that our quarantines intercept thousands of potential pests for each one that gets through.

3. Keep the total public properly informed of any newly introduced pests which show promise of becoming a real threat to our country.

4. Help the public to recognize new pests and encourage them to be on the lookout for them.

5. Emphasize need for reporting any strange pests and press for early identification of them.

6. Report the progress being made on any control operations.

7. Make known the importance of using public funds and that though they may be far from the base of operations, the expenditures may be for their protection.

8. Stress the need for basic research and relate the way such research pays off in control projects. Medfly bait spray attractants developed in Hawaii permitted immediate application in the Medfly control program in Florida.

The daily and weekly press, magazines, radio, and TV have done a magnificent job of informing the public about pest control problems and extend to a wide audience the advice of the colleges and Government agencies on pest control. Industry, commodity groups, and many others likewise have made noteworthy contributions in this field.

In fact, excellent support is given by almost everyone directly or indirectly concerned with the problem when they thoroughly understand and believe in it.

We can conclude, therefore, that eradication of an introduced pest or the prevention of its spreading may play an important part in our national economy; that good public relations are a necessary adjunct to a successful pest control program; that moulding public opinion is the job of all workers concerned with the program; and that all educational or informational media at our command need to be employed to produce the desired results.

MINNESOTA'S RURAL CIVIL DEFENSE ORGANIZATION

Roy V. Aune, Deputy Director
of Civil Defense for the State of Minnesota

Civil Defense is perhaps one of the more important yet underpublicized phases of defense with which we are confronted today. In discussing this matter with you, I would like to first outline the enemy capabilities and potential destructive power of modern weapons as employed in warfare as we know them. It is common knowledge, knowledge that can be gained by reading the newspapers and publications which are available to us from day to day, that the Russians to date possess the technical skill, know-how, and equipment to launch an attack against the Continental United States. Since they do possess this capability, let us examine the types of weapons and their potential destructive power.

Back in World War II, one aircraft manned by nine men was capable of delivering an instrument which was then considered very destructive, commonly known as the "ten ton block buster". This meant that the bomb delivered had the destructive capacity of ten tons of TNT. Today, we are confronted with a weapon that has a potential destructive capability of 20 million tons of TNT. This weapon can be delivered by one aircraft, and on a comparative basis we find that today one aircraft can deliver the same amount of destructive potential as back in World War II when it required two million planes and 18 million men to do the same job. These are the weapons with which we are confronted today, and we have read quite extensively of the damage that was wrought by atomic bombs that were dropped on Hiroshima and Nagasaki during World War II; these hydrogen bombs are a graduate version of the A-bomb and have a far greater destructive potential than those.

We are also hearing today of another contemplated type of weapon, that of the ICBM, or the Inter-Continental Ballistic Missile, which will, perhaps, be available to our Air Force, and since we have and are developing the technical know-how, there is no reason to believe that the Russians will not also be able to produce a like instrument. The ICBM's are missiles fired from launching sites, either within the Soviet Union or sites located in the Arctic Regions, which would be capable of striking targets in the Continental United States. The speed of travel of these is not officially known; however, it would be safe to assume, I believe, that these weapons would be able to travel from the site of launching to the target site in roughly 30 minutes, more or less. These weapons also carry a thermonuclear warhead and would deliver, roughly, the same potential destructive power as that of the bombs delivered by aircraft at the present time.

The next step, then, is to determine target areas. These have been listed for us by the Department of Defense in conjunction with the Federal Civil Defense Administration, and here in the State of Minnesota we have

five (5) target areas. One primary target, that of the Twin Cities Area, and four (4) target areas; namely, Duluth, East Grand Forks, Grand Forks, Fargo-Moorhead, and Sioux Falls, which would include a portion of the Southwestern corner of the State of Minnesota in Rock County. If an attack were launched against the United States and any one of these, or all of these, targets were hit, not only the area affected by the blast and the heat of the detonation of such a device would be of major concern, but also we would be concerned with radiological fallout resulting from such an attack. Radiological fallout is not contained in a target area alone, but travels with the wind adrift, and as such large portions of the State, or large portions of area downwind from the target area would also be affected by such fallout. In an effort to combat this in the State of Minnesota, we have attempted to familiarize the people through public education, through training in schools, through the distribution of radiological instruments and establishment of training programs in the operation of these instruments. To us in Minnesota, it is imperative that the rural areas be well organized to preserve those services and facilities which are essential to human life.

For the benefit of those people from other States, I would like to stress that the Civil Defense program of which I am speaking, is one which has been tailored to suit the needs of the people in Minnesota and taking into consideration the problems that we are confronted with here rather than perhaps the problems that might confront the people in your home state, so while you may disagree with some of the things I have said or may say in the future, I ask that you bear in mind that this program is tailored to our needs and to our situation, and that you may find that it would not be suitable in your own state. As I stated before, we feel that it is necessary to develop civil defense not only in metropolitan areas and incorporated municipalities in the State, but also in the rural areas and I would like to touch on that in a little more detail later on.

Next, I would like to just briefly outline to you the delegation of authority in the civil defense structure in the United States. Under the Federal government we have the Federal Civil Defense Administration, which is responsible for establishing the guidelines for over-all civil defense organizations and programs throughout the country, with the primary responsibility of implementation and tailoring of these plans to the needs of the individual states.

The Minnesota Civil Defense was created by an act of the legislature in 1951 establishing the Department of Civil Defense. The State has been broken down, for civil defense purposes, into five (5) geographical areas, namely, Mobile Support Areas, with each of these areas commanded by a fulltime State employee who is responsible to the State Director, who in turn, is responsible to the Governor of the State of Minnesota, the titular head of Civil Defense under the law. Then, under the Mobile Support Unit Commander and the Mobile Support Area we have county civil

defense organizations established in a direct line, or shall we say channel of command, in the State of Minnesota. From the county structure, we then split our delegation of authority into two channels, one to the incorporated municipalities where we have local civil defense organizations headed by a local director responsible to the mayor of that community and the other within the framework of the county organization. There we have a rural services division, which has primary responsibility for the radiological defense of the rural areas, biological and chemical defense, fire protection, and the housing and feeding of evacuees from evacuation areas. Also, we have a division which deals with the production of agricultural commodities during an emergency. There is a very definite need for the development of rural services in civil defense. The development of ready identification of foreign diseases, I believe, can be accomplished by cooperation of Federal agencies, State agencies, under the unified direction of a county civil defense organization. It will require the cooperation of everyone concerned. I believe that by establishing a standard operating procedure and a training program to assist the farmers throughout the State it will be possible to develop the personnel necessary to enable this identification not only in foreign diseases that might affect plants, but also animals and human beings as well.

The Federal Civil Defense Administration has made available to communities on a permanent grant basis certain radiological instruments, around which they can build training programs and organize comprehensive radiological defense teams. This equipment is made available to them without cost to the community. In the State of Minnesota this equipment has been distributed to many of the schools throughout the State where training programs are now in progress. Setting it up in this manner, we have been able to not only reach the people in the incorporated municipalities but also a large portion of the young people in high schools who are from the rural areas. This, of course, means that without any additional training programs or additional organization we have been able to get information and training out to people in the rural areas. The way this works is, that the training and the use of these instruments are carried on in the regular physics or biological classes in the schools training the juniors and seniors in the use of these instruments. We hope this year we will be able to train the junior and senior classes and in subsequent years train the junior classes so that we always have at least one year reserve of trained personnel in the community at all times. You understand that one of the problems confronting the rural areas today is the fact that upon graduation from high school many of the seniors leave, either to continue their education in some college or to seek employment in a more metropolitan area, leaving the home town and the home community without the benefit of their training or experience. We have placed 128 of these radiological training kits throughout the State so far; there are approximately 56 additional kits on requisition to the Federal government at the present time, and these will be distributed to municipalities as soon as they are received in the State.

The Radiological Program, or Radiological Defense is perhaps a better term for it, will have the responsibility of detecting and determining the intensity of fallout in any given area. This information will be forwarded to the higher headquarters where plotting of information will be made. In addition to this, we must also consider the necessity for decontamination procedures, lay plans for possible evacuation of radiological fallout areas based on forecasts received from the U. S. Weather Bureau and State Civil Defense Organization.

In other fields of civil defense as it affects rural areas, we must of necessity look to the Federal government and its agencies for guidance and assistance to the rural areas developing the plans which would enable them to develop plans and trained personnel. The County Agent is perhaps the key man in rural civil defense; however, he will require the assistance of other government agencies such as Soil Conservation Service, Department of Agriculture, the ACS people and other technical services that are available to him.

Much of this activity today seems to be unnecessary to us but in the event of an emergency it is imperative that we have a good plan and fully-trained organization, both in the rural areas as well as in the incorporated municipalities. We hope that it is never necessary to put these emergency measures into operation. However, if it is needed, let us hope that we have it and that the good Lord will be with us.

FILMS

GRASSHOPPERS CAN BE CONTROLLED (Color; released 1955; 21½ minutes)

This film demonstrates how grasshoppers can be controlled through individual and community action. It explains conditions under which serious outbreaks of grasshoppers may develop. Film is also available as a TV short in black and white.

GYPSY MOTH (Color; released 1955, 28 minutes)

This film traces the gypsy moth from its escape in Massachusetts in 1869 and highlights Federal-State activity attempts to control the pest. Film also available as a TV short in black and white.

STEM RUST (Color; revised 1956, 13 minutes)

This is a story of stem rust, a fungus disease that destroys wheat, oats, barley and rye. It explains the nature of the disease, how it damages the grain, and how barberry bushes which spread the disease are being destroyed. Film is also available as a TV short.

GOLDEN NEMATODE (Color; released 1957, 38 minutes)

Film outlines factors related to the over-all research and control programs pertaining to the golden nematode problem.

Copies of the films listed above are available for loan purposes from the Motion Picture Service, Office of Information, U. S. Department of Agriculture, Washington 25, D. C., and the Regional Offices, Plant Pest Control Division, Agricultural Research Service, U. S. Department of Agriculture.

SLIDES

SOYBEAN CYST NEMATODE (Color, 2x2 series)
WITCHWEED - STRIGA (Color, 2x2 series)

The slide series are available for loan purposes by the Regional Offices, Plant Pest Control Division, Agricultural Research Service, U. S. Department of Agriculture.

VISUAL AIDS IN PRODUCTION

FILMS

MEDITERRANEAN FRUIT FLY
KHAPRA BEETLE
JAPANESE BEETLE

16mm. films (color) on the above subjects are now in production and will be ready in the near future for loan purposes from the Motion Picture Service, Office of Information, U. S. Department of Agriculture, Washington 25, D. C., and the Regional Offices, Plant Pest Control Division, Agricultural Research Service, U. S. Department of Agriculture.

SLIDES

BARBERRY ERADICATION
BURROWING NEMATODE
BLACK FLY
GYPSY MOTH
KHAPRA BEETLE
MEDITERRANEAN FRUIT FLY
MEXICAN FRUIT FLY
WHITE-FRINGED BEETLE

2x2 color slide series on the above subjects are in the process of reproduction and will be available about August 1 for loan purposes by the Regional Offices, Plant Pest Control Division, Agricultural Research Service, U. S. Department of Agriculture.

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